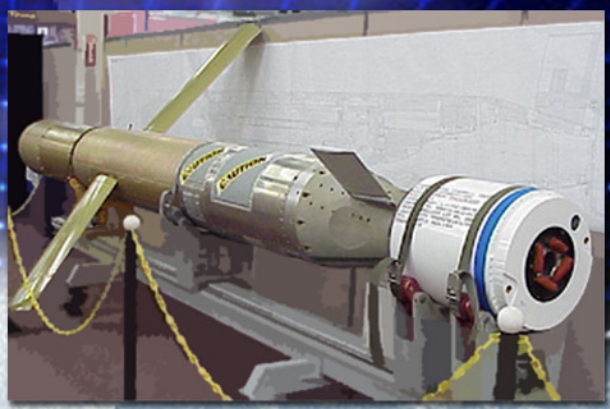
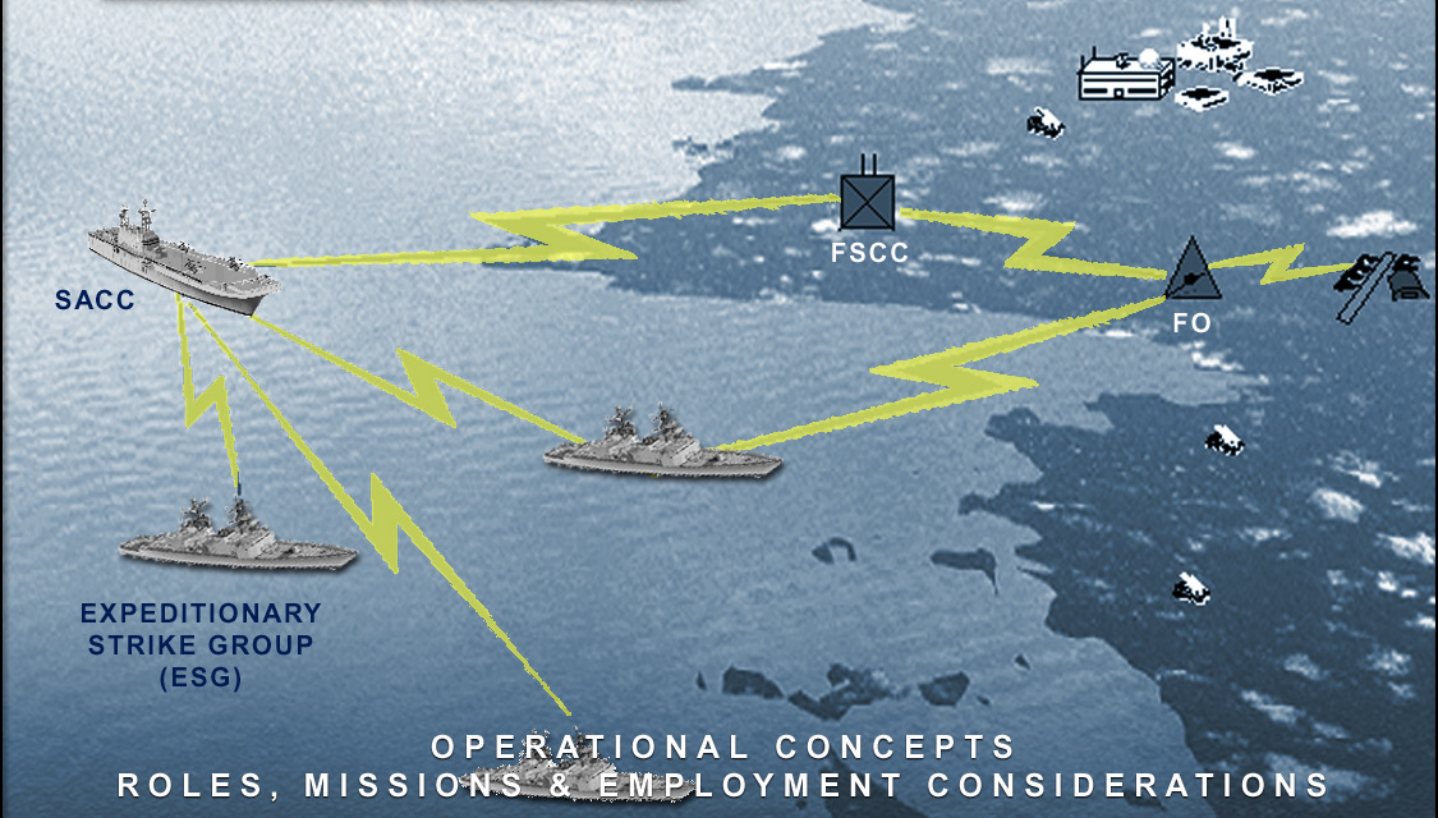
CONCEPT OF OPERATIONS FOR

SURFACE COMBATANT LAND ATTACK WARFARE

2005 - 2015





OPERATIONAL CONCEPTS
ROLES, MISSIONS & EMPLOYMENT CONSIDERATIONS

OCTOBER 2002

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EXECUTIVE SUMMARY

This *Concept of Operations for Surface Combatant Land Attack Warfare 2005–2015* is the second iteration of bringing together the various systems and capabilities for Navy surface combatants to project combat power ashore.

This document updates and replaces the July 2001 version of the *Concept of Operations for Surface Combatant Land Attack Warfare 2005–2015*. It will be updated periodically as established by the Land Attack Capstone Organization memorandum of agreement to ensure that new capabilities and evolving concepts are incorporated. The scope of this document has been intentionally limited to land attack and specifically to naval surface combatants. This document is intended to provide the Navy and Marine Corps doctrine centers with information on the surface navy's emerging capabilities to support ongoing doctrine development or revision. It also provides practical guidance to the training community in the development of land attack related course curriculum.

The surface combatant Navy has been developing weapons, sensors, command and control systems, and tactics to project offensive firepower into the littoral battlespace. Many of the weapon systems have been incrementally improved while at the same time new weapons and capabilities have been under development. A recent enhancement was the introduction of an upgraded 5-inch naval gun system in 2001 to complement the existing Tomahawk cruise missile capability. This will be followed in 2004 with the Tactical Tomahawk cruise missile with an operational range of over 1,000 nautical miles, and the extended range guided munition in 2006 with a range of over 50 nautical miles. These new land attack missile and gun weapons will use the global positioning system to provide all-weather, highly accurate, and lethal fires.

Each of these weapon systems is driven by a system specific operational requirements document and is managed by a separate program office. The challenge is to merge these individual weapon systems, as well as emerging and proposed future systems, into an overarching surface combatant land attack family-of-systems to provide a responsive and sustained end-to-end mission capability for the full spectrum of fire support and strike targets.

Concept of Operations for Surface Combatant Land Attack Warfare 2005–2015 provides a vision of how surface combatants will employ their new and emerging land attack command, control, communications, computers, intelligence, surveillance, reconnaissance, and targeting (C4ISRT) assets and weapons to provide the transformational capability described in SEA POWER 21 for the 2005 to 2015 timeframe. By fully implementing this vision, surface combatants will become a key component in a fully networked, jointly integrated, and sea-based power projection force.

This document describes five operational roles for surface combatants, from supporting maneuver units ashore to singe-ship strike operations. Each role inserts additional land attack systems and increasing levels of system integration, resulting in faster response times, sustained and flexible firepower, coordinated and synchronized fires across multiple dispersed platforms, and lower operator workloads.

To fully realize these new land attack capabilities, corresponding advances are required in theater and platform command and control, coordination, communications, targeting, and logistics. Each of these areas is addressed in separate chapters and some new concepts are proposed. Additionally, challenges in several key

areas of land attack warfare have been noted in the document:

- The appropriate level of organic land attack capability for an individual surface combatant needs to be defined. This is particularly important as surface combatants operate more independently such as when supporting a flexible forward presence.
- A naval targeting architecture needs to be defined, along with a clearly definable OPNAV sponsor. This common architecture should provide for a transparency of fires that combines the currently separate strike and fire support systems. This integrated architecture will use organic and external sensors, interoperable command and control systems, and weapons to rapidly deliver the desired effects on the target.
- Responsive land attack warfare requires real-time air space coordination to prevent fratricide of weapons, weapons platforms, and friendly ground assets. Potentially thousands of land attack weapons per hour will be flying various profiles to targets across the joint battle space, greatly complicating the creation of a single integrated air picture. Currently the air defense and land attack command and control systems lack a method of rapidly exchanging information.
- Other challenges in land attack warfare include, but are not limited to volume fires, replenishment at sea, counterfires, Aegis integration, and over the horizon communications.

The absence of a land attack capstone requirements document has allowed numerous system specific operational requirements documents (ORDs) to proliferate without concern for the interoperability and coordination required across the joint forces conducting land attack warfare. The *Concept of Operations for Surface Combatant Land Attack Warfare 2005–2015* was developed to bring together the capabilities of numerous programs and systems that are being developed and to merge their employment into an integrated concept of operation.

1.0 INTRODUCTION

This chapter provides an introduction to the mission area of land attack, along with the purpose, scope, and approach used in developing this document.

1.1 PURPOSE

In the fall of 1999, Director of Surface Warfare created the Surface Combatant Land Attack Warfare Capstone Organization to synchronize requirements and programs, eliminate unnecessary duplication, and make the most effective use of existing and future resources across the multitude of affected system commands, program executive offices, and program offices. This Capstone Organization created the Concept of Operations and Doctrine Working Integrated Product Team (C&D WIPT), chaired by N764G1, to:

- develop, publish, and periodically update an overarching concept of operations (CONOPS) focused on surface combatant land attack warfare
- ensure that the evolving platform-level capability requirements support the naval and joint warfighters
- support the development of associated doctrine in concert with the Navy Warfare Development Command (NWDC) and the Marine Corps Combat Development Command (MCCDC)

In response to the above requirement, this document updates and replaces the original version of the *Concept of Operations for Surface Combatant Land Attack Warfare* dated July 2001 and focuses on how the naval surface combatant will conduct land attack warfare in the 2005 to 2015 timeframe. The purpose of this document is to:

- focus the land attack systems engineering effort by setting forth the manner in which supported ground forces will employ a capability not previously resident in surface combatants accelerate the discussions necessary for the future development of doctrine and tactics, techniques and procedures (TTPs) to govern the use of this developing capability
- provide practical guidance to the engineering community on surface combatant land attack warfare capability requirements and their proper technical interpretation
- provide a source document for the acquisition and training communities to use in curriculum and courseware development
- provide a common frame of reference so the Land Attack Capstone Organization can begin to coherently address the multitude of issues that are raised in this document

This document provides the concept of operations of how surface combatants[1] will employ their new command, control, communications, computers, intelligence, surveillance, reconnaissance, and targeting (C4ISRT) and weapon assets to provide a revolutionary capability to conduct joint land attack warfare in the 2005 to 2015 timeframe. Although tactical naval aviation and submarines are outside the scope of this version of the document, their contribution to land attack warfare is acknowledged.

1.2 APPROACH

The initial concept of operations dated July 2001 has been reviewed and signed by the Surface Combatant Land Attack Warfare Executive Steering Committee. The initial CONOPS document defined land attack warfare; described surface combatant land attack missions, roles, and capabilities; identified the external land attack related agencies and systems, and the Marine Corps fire support requirements. Furthermore, it set forth some land attack weapon employment

[1] For the purpose of this document, surface combatants are defined as cruisers and destroyers that employ the land attack systems mentioned in this document.

considerations and identified land attack operational issues requiring resolution.

The goals of this revision of the CONOPS are to address the four key issues identified in the initial document (deconfliction, mission planning and targeting, force level command and information flow, and logistics), address some additional issues that were identified during the review process, and to present a set of architectural operational views (Chapter 4) to support the employment concepts defined in this document. As a first step in developing this document, a two-day workshop was held 24–25 October 2001. This workshop was designed to garner a broad range of input from subject matter experts representing the fleet, government agencies, and private industry. Participants were assigned to one of the four sub-groups, and each sub-group focused on one of the four key issue areas identified above. At the end of the workshop, each sub-group provided a list of key issues and recommended solutions. The product of the workshop, along with additional research, has been incorporated into this document.

1.3 BACKGROUND

During World War II, the primary employment of naval gunfire shifted to supporting amphibious operations and proved critical in enabling forcible entry operations against many heavily defended beachheads. The roles of naval gunfire support in these amphibious operations included: (1) delivering high volume bombardment and beach preparation fires to clear obstacles and neutralize enemy coastal defenses necessary to enable assault forces to establish positions ashore; (2) destroying critical targets necessary to ensure the seizure of the force beachhead; (3) interdicting and/or neutralizing counterattack forces to enable the landing force to fully transition and buildup combat ashore; and (4) attacking deep targets to support the breakout or continued operations of the landing force.

During the Cold War, the surface Navy concentrated on undersea warfare and anti-air warfare to defend aircraft carriers and sea lines of communication from the former Soviet Union's air and submarine threats. This blue-water period was highlighted by two significant trends: a reduction in the number and size of naval guns, and the introduction of the first air-defense missile systems on surface combatants. In the 1970s the Navy eventually adopted the 5-inch/54-caliber gun as its standard. This 13 nautical mile range gun was intended for general-purpose use against surface craft, slow moving aircraft, and near shore targets. In the 1980s and 1990s ships and submarines were augmented with the Tomahawk cruise missile system to provide a deep conventional and nuclear land attack capability.

With the breakup of the former Soviet Union in 1989, the Navy increased its focus on littoral operations by developing capabilities to more effectively influence events ashore. In light of modern defensive systems designed to counter traditional World War II amphibious operations, new operational concepts were required to effectively employ limited resources while minimizing both casualties and collateral damage.

1.4 NEW OPERATIONAL CONCEPTS

In the mid-1990s, the naval services defined their vision for the future in *Forward…From the Sea*.[2] This document restructured naval expeditionary forces for joint operations, thus requiring that naval fires systems be fully integrated with the emerging joint fires architecture. The vision called for an offensive maritime force for sustained operations in the challenging littoral regions.

Today's naval forces are continuing the transformation across a broad front to achieve a networked and sea-based power projection force that will enable joint force operations, deliver

[2] *Forward…From the Sea*, signed by SecNav, CNO, and CMC, dated 19 September 1994.

long range effective firepower, and assure sustained global access for U.S. forces.

1.4.1 NAVAL TRANSFORMATION ROADMAP[3]

The Naval Transformation Roadmap is a new operational construct that will transform the Navy to meet the wide array of 21st Century threats, and will fully integrate naval forces with the other joint forces operating across a unified battlespace. Four capabilities drive the *Naval Transformation Roadmap (Power and Access… From the Sea)*: Sea Strike, Sea Shield, Sea Basing, and FORCEnet.

- Sea Strike will project dominant, long range, decisive, and precise offensive power against key enemy targets using a wide array of means, both lethal and nonlethal, including long-range aircraft and missiles, information operations, Special Forces, and Marines. Success depends upon acute situational awareness, rapid and secure methods of sharing knowledge, and networked forces fully integrated into joint and national systems.
- Sea Shield will project both near and long range defensive power from the sea to protect the nation with forward deployed forces, assure allies and deter potential adversaries, assure theater access, and protect the joint forces ashore. Enhanced intelligence, surveillance, and reconnaissance (ISR) systems will provide the information superiority, and will build upon the tenets of network centric warfare. A mixture of manned and unmanned ISR systems will provide the foundation for battlespace dominance, and enable the capability to project defensive firepower deep overland.
- Sea Basing will use 70% of the earth's surface as a vast maneuvering space to extend sovereignty around the world and provide support for joint forces. The independence of naval vessels operating on the high seas allows the U.S. to conduct combat operations anywhere and anytime, without asking for permission. Basing joint command and control, fire support, and logistics assets at sea provides the capability to immediately respond to a conflict, reduces the logistical footprint ashore, and minimizes airlift and force protection requirements. Warfighting capabilities are distributed across multiple sea-based platforms networked together and integrated with assets ashore to provide a unified joint battlefield.
- FORCEnet will integrate naval, joint, and national information grids to achieve unprecedented situational awareness and knowledge management. This concept will provide the joint force commander with secure, highly mobile, in-theater afloat headquarters, and will take advantage of the advances in communication and sensor technologies.

A Navy built around the above concepts will provide the nation with a highly adaptable fleet ready to strike at a moment's notice. This fleet will deploy expeditionary strike forces (ESF) that include:

- Carrier strike groups (CSGs) to respond to the full spectrum of conflicts
- Expeditionary strike groups (ESGs) composed of amphibious ready groups with dedicated escorts optimized for littoral power projection missions.
- Surface/submarine action groups to conduct precision strike, sea control, maritime intercept, and intelligence operations

1.4.2 Operational Maneuver From the Sea[4]

The Marine Corps' concepts for the projection of naval power ashore, Operational Maneuver From the Sea (OMFTS) and Ship-to-Objective Maneuver (STOM), attempt to fully exploit the tenets of maneuver warfare in the challenging littoral environment. These concepts capitalize on existing and emerging technological advancements in

[3] *Naval Transformation Roadmap (Power and Access… From the Sea),* Draft document dated June 2002.

[4] OMFTS is the operational implementation of the Marine Corps Capstone Concept *Expeditionary Maneuver Warfare,* dated 10 November 2001.

mobility, information management, and the range, lethality and responsiveness of naval fires to conduct forcible entry from the sea rapidly striking directly at an enemy's center of gravity thus avoiding set-piece, phased and highly rigid amphibious operations of the past. Significant advancements in the mobility of expeditionary forces enable them to maneuver from over-the-horizon directly to objectives far inland exploiting the full limits of the sea, air and land in an expanded battlespace.

The successful implementation of OMFTS is highly dependent on improved sea-based command-and-control, logistics, and supporting fires. Highly mobile and therefore lighter maneuver forces employed in OMFTS require long-range, highly responsive, highly lethal, accurate and continuous supporting naval fires. The longer ranges and improved responsiveness of naval fires also make them capable of supporting emerging lighter and more mobile Army forces, particularly those participating in early entry operations in the littorals. These supporting naval fires will be provided by a new generation of mutually supporting air, ground, naval surface and sub-surface assets.

1.4.3 Future Naval Fires[5]

The rapid application of integrated fires from dispersed formations throughout the battlespace in support of simultaneous joint operations will require a shift from platform-centric to network-centric warfare (NCW). NCW is a concept centered on a vast, complex information infrastructure, linking geographically dispersed warfighters at all levels to increase force synergy, combat power, and operational effectiveness. The physical infrastructure is envisioned as a global information grid providing seamless back-plane connectivity to support a sensor grid, a command and control grid, and an engagement grid[6] (figure 1-1). This overarching network is intended to provide rapid global information dissemination and transfer, enabling theater and global information superiority and joint C4ISRT integration.

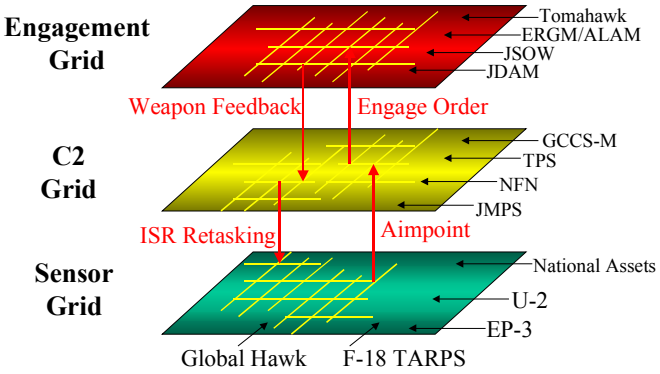

Figure 1-1. Global Information Grid

To create an operational capability out of the NCW concept, one single overarching family of systems (FoS)[7] must integrate these three grids to both enable rapid self-synchronization and decisive actions, and to provide a sensor to weapons-on-target warfare mission capability.

1.4.3.1 Sensor Grid

Advances in sensing capability as well as the distribution of sensor data are required to support this family of systems. A sensor grid capable of providing continuous surveillance down to the tactical level throughout the battlespace is required to achieve the full potential of future naval fires. This sensor grid will integrate information from all available sensors into a common information base that will support the other two grids. It will overlay intelligence and surveillance information from multiple joint sensors and quickly detect, classify, and precisely locate targets for disposition by the command and

[5] Based on the *Future Naval Fires* White Paper published by NWDC, dated Apr 2002.

[6] Example does not show all existing or potential systems that would be included in the global information grid.

[7] The FoS includes legacy, emerging, and developmental systems working together.

control, and engagement grids. This overlaying process will be accomplished through automating, coordinating, and correlating the processing of multiple tactical data streams from various surveillance and intelligence sources in near real-time.[8] The sensor grid will then provide time-critical cueing information for advanced sensor systems as well as precision targeting coordinates for advanced weapon systems.

1.4.3.2 Command and Control Grid

Command and control of naval fires must be flexible and scaleable, allowing the linking of multiple control nodes throughout the strategic, operational, and tactical levels of battle. The system must allow the control node to pass engagement orders to individual firing units. It must also be capable of operating in a decentralized manner using command by negation to override any unwanted engagements. This flexibility will allow control nodes to exist at the combatant commander level located far from the engagement, in theater on either a navy ship, ashore with the ground combat commander, or on an enhanced command and control aircraft. Additionally, the system must have the capability for programmable or selectable levels of unmanned systems autonomy. This flexible network architecture will allow for high-level control of engagements during contingencies as well as tactical level synchronization when required by the tempo of operations and enabled by the appropriate rules of engagement.

Speed of command will flatten the command hierarchy, place decision makers in parallel with shooters, and transform warfare from multiple, discrete functions into a single, continuous process. Once implemented, commanders will be able to collaboratively plan and execute missions in a dynamic environment with accurate, timely, and sustained situational awareness. Similarly, on-scene commanders will be able to rapidly respond to battlefield developments and decisively influence events. Advanced C4ISRT networks, the backbone that supports the entire structure, will integrate tactical and technical support applications with connections to enhanced satellite systems and other networks.

Deconfliction tools must be developed that allow both the firing platform and other joint assets to rapidly deconflict ordnance flight paths to assist in rapid, safe engagements and enable horizontal, fully integrated operations.[9]

1.4.3.3 Engagement Grid

The family of systems must be capable of generating fire control solutions, executing engagements, monitoring and managing engagements in progress, and providing data links between sensors and weapons. Every weapon capable of receiving in-flight target updates could be assigned a network address. This information must be passed to the sensors in the network that individually or in aggregate are responsible for providing updated data to the munitions to ensure in-flight target updates are correctly transmitted and acted upon by the desired ordnance. Additionally, engagement control would include the management and scheduling of sensors to ensure that fire control quality data is available at the appropriate time during the weapons' flight path.

The engagement grid also plays a role in the deconfliction process. Examples of potential technology assisted deconfliction are: (1) the capability to automatically display ordnance flight paths prior to the firing of the ordnance as well as when the ordnance is in-flight, (2) shipboard combat direction systems that communicate with each other and generate alerts about flight path conflicts, and (3) ordnance that communicates with

[8] CJCSM 3500.04B Universal Joint Task List, 1 Oct 99, OP2.5.3 defines near real-time as "…within 5 seconds to 5 minutes of occurrence."

[9] Deconfliction as a subset of coordination is addressed in detail in Chapter 6.

airborne systems to generate alerts about potential collision situations. Technology assisted deconfliction will allow rapid engagement of time sensitive targets and dynamically coordinated strikes. Additionally, information regarding munitions and aircraft flight paths must be provided to friendly air defense networks to prevent an inadvertent response to our own weapons.

1.4.4 Land Attack Vision

Because naval forces are forward deployed in international waters, they will often be on the scene before trouble starts. In the war on terror they will be the land attack weapons that wait providing the volume of precision fires across the littorals and "Denying enemies sanctuary by providing persistent surveillance, tracking, and rapid engagement with high volume precision strike, through a combination of complementary air and ground capabilities, against critical mobile and fixed targets at various ranges and in all weather and terrains."[10] Surface combatants and submarines will bring unique all-weather, day/night, sustainable, and responsive fires as a complement to the capabilities provided by aircraft carriers and their embarked air wings. These enhanced land attack capabilities are the result of advances in sensors, precision targeting systems, weapons, information exchange, and integrated command and control systems. Once all of these components are fully integrated, surface combatants and submarines will have the capability to conduct early, responsive, and precision tactical, operational, and strategic land attack missions while supporting the arrival of follow-on naval, joint, and coalition forces.

Director of Surface Warfare (N76)[11] has defined land attack as the integrated employment of available sensors, weapons, and joint and coalition forces for projecting combat power into and on the ground portion of the battlespace to protect vital national interests and achieve national and military objectives. Employed forces can include aviation and sea- and ground-based assets. Figure 1-2 highlights how land attack warfare fits into the larger concept of joint, naval, and Navy fires. This figure focuses on naval surface combatant land attack.

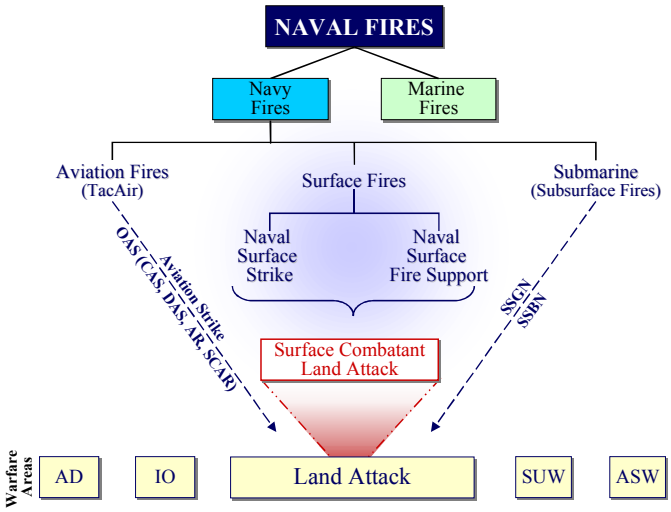

Figure 1-2. Land Attack Warfare Concept

1.4.4.1 Land Attack Missions

For the surface combatant, land attack warfare encompasses the dual missions of naval surface fire support and naval surface strike.

Naval surface fire support (NSFS) encompasses fires provided by Navy surface gun, missile, and electronic warfare systems in support of a unit or units tasked with achieving the commander's objectives.[12] NSFS is usually associated with support of ground maneuver forces.

Naval surface strike (NSS) is the destruction or neutralization of enemy targets ashore through the use of conventional weapons provided by surface combatants. These targets consist of strategic, operational, and tactical targets capable of

[10] Operational goal from *Quadrennial Defense Review Report*, dated 30 September 2001.

[11] The Director of Surface Warfare (code N76) is on the Chief of Naval Operations Staff, responsible for the development of surface warfare requirements and resources.

[12] Definition from Joint Pub 1-02, *DOD Dictionary of Military and Associated Terms*.

conducting operations against U.S. or Allied forces.[13] These missions are characterized by attacks on strategic centers of gravity, war-making capacity, the will to make war, and military targets not directly in contact with friendly forces. NSS is usually executed independent of ground maneuver forces.

1.4.4.2 Land Attack Roles

Surface combatants must be fully capable and responsive across the entire spectrum of warfare, from major theater war to small-scale contingencies (such as precision strikes against terrorist cells, training facilities, and staging areas) and non-combatant evacuation operations; from multi-ship battlegroups to independent operations. While conducting these operations, the surface combatant will perform one or more of the following roles.

Development of the Roles

The following role descriptions were developed by a working group and were approved and set forth in the Director of Surface Warfare letter dated 11 September 2000. The firing unit role was added later.

These five roles provide a useful model for surface combatant employment for land attack missions. They should not be viewed as a comprehensive classification of all possible situations, but neither should they be considered as merely a cursory classification effort.

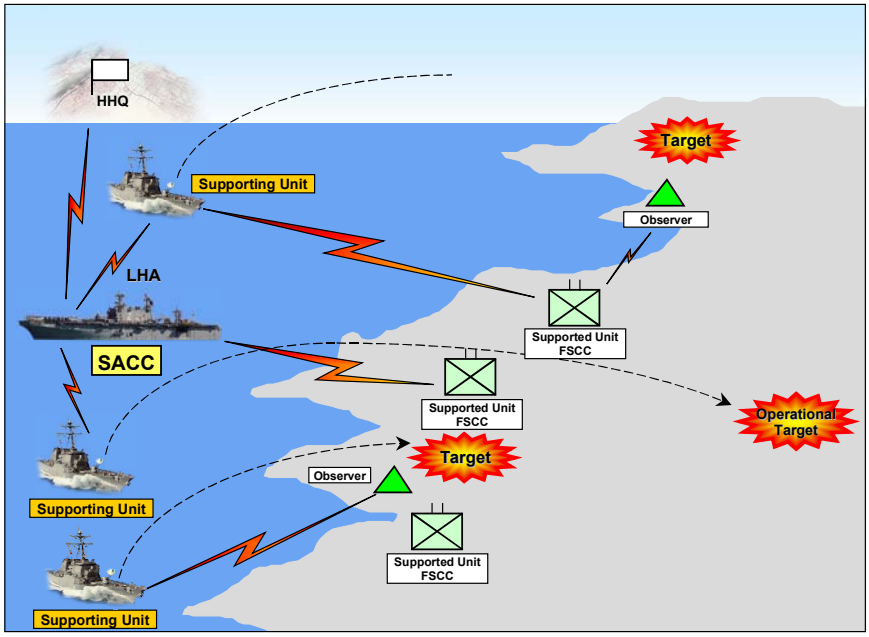

Figure 1-3. NSFS Supporting Unit

The NSFS Supporting Unit (figure 1-3) provides fires in support of maneuver forces operating or preparing to operate ashore. In this role, surface combatants receive orders to fire from a fire support coordination agency of the supported unit via network connectivity or directly from a forward observer. The network connectivity flows through either the supporting arms coordination center [(SACC) as depicted] or a controlling unit.

[13] Director of Surface Warfare (code N76) memorandum, *Surface Combatant Land Attack Warfare Guidance Document*, Ser: N864/OU653919, dated 11 September 2000.

The NSFS Controlling Unit (figure 1-4) directs and controls the fires of two or more surface combatants in support of maneuver forces operating or preparing to operate ashore. The controlling unit receives requests for fire support from fire support coordination agencies, processes the requests in accordance with appropriate commander's guidance and rules of engagement (ROE), and assigns one or more ships under its control to provide the requested fires. A ship in this role conducts tactical fire direction for supporting units.

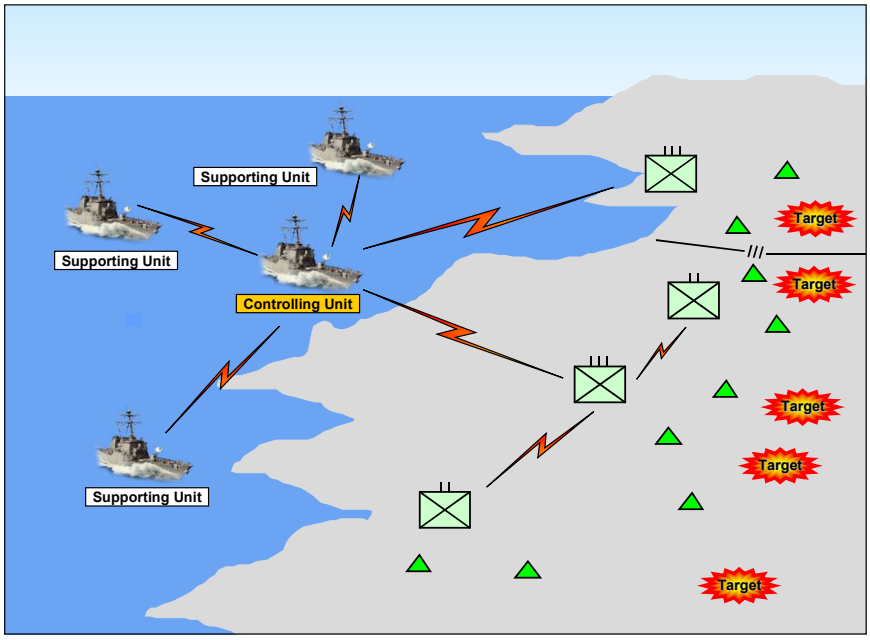

Figure 1-4. NSFS Controlling Unit

The NSS Single Unit (figure 1-5), a single surface combatant operating alone, either by design or in anticipation of a greater force arriving in theater, must be capable of planning, targeting, controlling, synchronizing, integrating, coordinating, executing, and assessing own ship fires. The ship will receive mission orders, commander's guidance, and ROE from higher authority, with no higher level on-scene commander or fires coordinating element in the area of operation. The ship will execute fire missions based upon surveillance and targeting data provided by reconnaissance and surveillance elements ashore or organic or off-board targeting systems. The ship will have the authority to determine which targets to engage, with what weapons, and to what degree, consistent with mission orders, existing ROE, and commander's guidance.

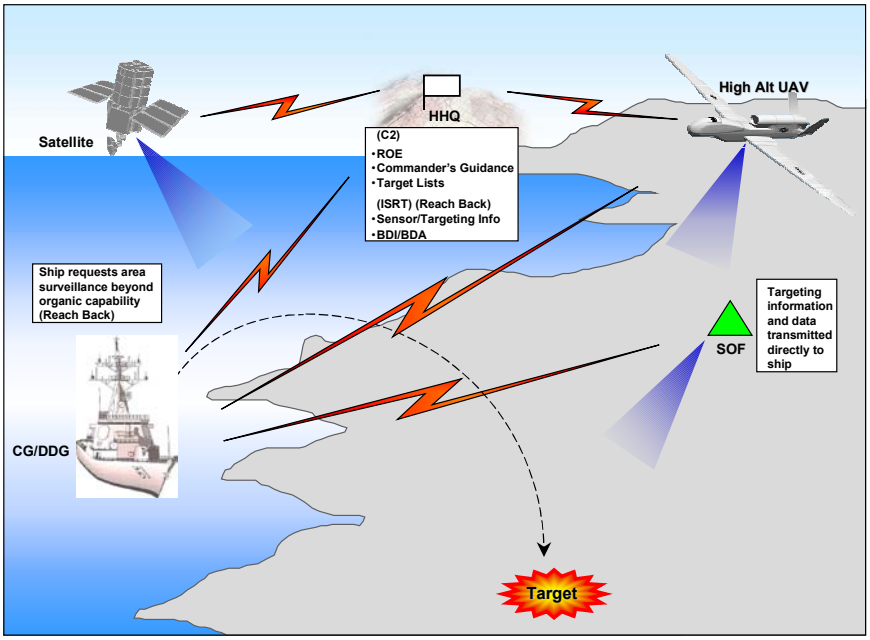

Figure 1-5. NSS Single Unit

The NSS Multi-Unit Commander (figure 1-6) directs and controls the fires of a group of surface combatants operating together but apart from a battlegroup or other controlling agency ashore while conducting NSS missions. The multi-unit commander will plan, target, synchronize, integrate, coordinate, execute, and assess the results of fires for the group.

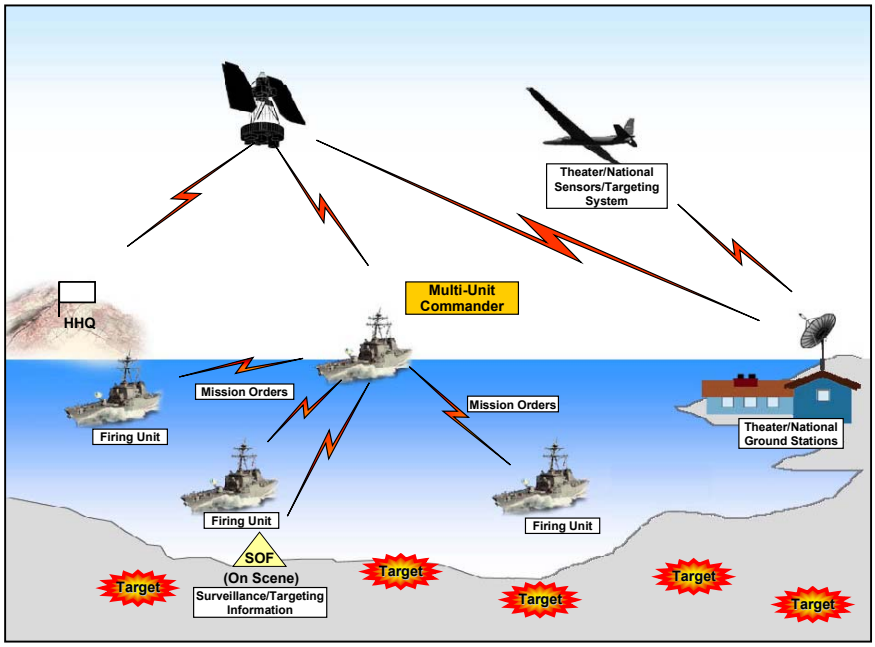

Figure 1-6. NSS Multi-Unit Commander

The NSS Firing Unit (figure 1-7) conducts strike missions as directed by either the Tomahawk strike coordinator or the NSS multi-ship commander (as depicted).

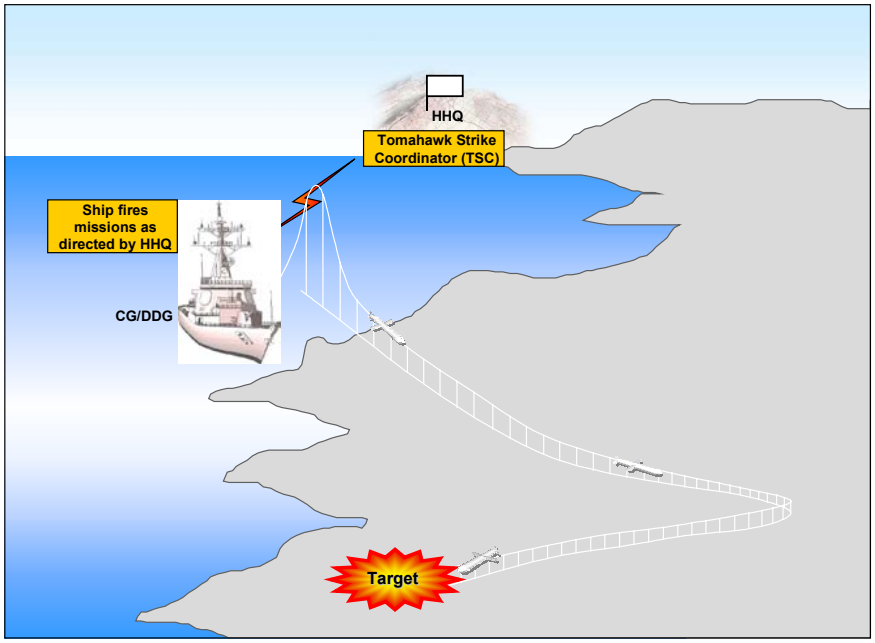

Figure 1-7. NSS Firing Unit

1.4.4.3 Land Attack Tenets

The following tenets summarize the naval services' land attack vision:

- Land attack will be offensive, integrated, network-centric, and sea-based
- In conjunction with maneuver, land attack will be the primary means to engage an adversary
- Land attack will be executed at the strategic, operational, and tactical level and at the lowest possible echelon

- Land attack will be sufficiently flexible to successfully engage fixed, mobile, time critical, and hardened targets at long ranges
- Land attack will have the capability to provide both precision and volume fires over a sustained period
- Land attack assets will be dynamically allocated, coordinated, and deconflicted from a network-based architecture
- Land attack system design will use human-systems integration based on human centered design principles
- Land attack systems will meet joint interoperability requirements

In short, land attack warfare will include the full spectrum of tactical, operational, and strategic attack capabilities. These capabilities will be fully integrated, coordinated, and synchronized with the joint force commander's concept of operation and target priorities, and the ground commander's scheme of maneuver. Joint systems integration will allow the Navy to focus on providing the required effects, at the required locations, and at the required times. This land attack vision necessarily portends fundamental organizational and doctrinal changes across the joint services to fully exploit these new capabilities. Once these changes are made, the capability to provide tactically responsive fires at long ranges to maneuvering ground forces can be leveraged to successfully engage time critical targets within their window of vulnerability.

1.4.5 Land Attack Implementation Plan

In 1994, the Navy realized that it needed a comprehensive near and far term strategy to develop a land attack capability to support its evolving operational maneuver doctrine. For the near term, the Navy's objective is to leverage existing systems to provide capability as soon as possible. This will be accomplished through an aggregation of incremental improvements to existing gun, missile, weapon control, and C4ISRT systems, as well as leveraging global positioning system (GPS) technology to allow extended range munitions to achieve precision accuracy. These near term improvements will add to the Navy's land attack capabilities, but they are neither intended nor expected to meet all of the Marine Corps' stated NSFS requirements.[14]

The Navy has recently established the DD(X) program to produce a family of advanced technology surface combatants designed to meet multi-mission warfare areas to include littoral warfare operations. Completion of the lead ship is expected in 2012. Among this family will be the DD(X) destroyer, a CG(X) cruiser, and a littoral combat ship. Technology developments are expected to include a 155mm advanced gun system and new land attack missiles to meet the ground forces' requirements for range, lethality, sustainability, volume of fire, and responsiveness. The Navy will employ unmanned aerial vehicles (UAVs) to perform surveillance and reconnaissance missions.

These new land attack platforms and systems will provide commanders a greater choice of weapons than formerly available. The current practice of employing naval guns for short-range tactical missions and Tomahawk missiles for long-range strike missions will be modified in favor of putting the desired effects on target from the most suitable weapon available. For example, Tactical Tomahawk is designated to serve as an interim tactical missile until the advanced land attack missile is deployed. The specific mission objectives and constraints will determine selection among the advanced gun, land attack missile, or cruise missile weapons. These new capabilities will allow land commanders to balance maneuver with fires to meet their operational goals.

[14] *NSFS Requirements for Expeditionary Maneuver Warfare*, Commanding General (CG), Marine Corps Combat Development Command (MCCDC) letter, dated 19 March 2002.

2.0 NAVAL FORCES LITTORAL THREAT CONTINUUM

This chapter discusses conventional and unconventional threats to naval surface forces operating in the littoral.

2.1 INTRODUCTION

Naval forces operating in the littoral in the near to mid-range timeframe (2005 to 2015) will face a variety of threats and will be required to engage a large number and variety of targets. Threats will derive from hostile (rogue) nations as well as non-state actors that may be ethnic, religious, or criminal-based. These threats will increase in sophistication and lethality further into the mid-range timeframe. However, most potential threat entities may not have procured the more sophisticated weapons in large numbers. Even if procured, the weapons systems must be employed properly which may require a significant training infrastructure, or alternatively, foreign advisors. Fire-and-forget weapons must also be properly employed to be effective. If rogue nations and non-state threat entities do not choose to upgrade their arsenals, due to fiscal or other reasons, lower technology weapons will continue to pose a danger to friendly naval forces.

The threat to naval forces will vary depending on the scenario. The principal threat will be to the naval units operating in the littoral, the forces involved in the ship-to-objective phase of operations, and the sensors and sensor platforms supporting these operations. Threat entities may seek to interdict or degrade the effectiveness of naval surface fires and associated command and control networks. Terrorists may also pose a threat to naval forces in their homeport, overseas, or while underway.

2.2 CONVENTIONAL LITTORAL DEFENSES

Naval forces, networks, and naval fires ordnance are susceptible to attack from a wide variety of enemy weapon systems and information warfare-related activities. This tactical activity can be categorized as reactive or proactive depending on the normal mode in which they engage their targets. The following lists define what is meant by each category, and provide examples of weapons systems or platforms that typically fall into that category.

2.2.1 Reactive Defenses

Weapons systems or platforms that react to the approach of opposing forces:

- coastal defense cruise missiles (mobile or fixed)
- coastal defense artillery (mobile or fixed)
- coastal defense torpedoes (fixed)
- mines
- integrated air defense systems
- ground forces (patrols and garrisons)
- aircraft (defensive counter air and close air support)
- patrol boats (can be equipped with cruise missiles, torpedoes, and guns)
- radio-frequency weapons

2.2.2 Proactive Defenses

Weapons systems or platforms that seek and engage opposing forces:

- surface combatants (can be equipped with surface-to-surface missiles, surface-to-air missiles, torpedoes, and guns)
- aircraft (offensive counter air and strike aircraft)
- special operations forces (SOF)
- submarines (including mini-subs)
- tactical ballistic missiles (TBMs)
- information warfare attack operations designed to deny, deceive, disrupt, or destroy

Table 2-1 summarizes the type and basic capabilities of threats likely to be encountered in the near to mid-range timeframe. As higher technology weapons proliferate, threat capabilities will improve. The ranges provided are average. Some specific higher technology weapon systems may greatly exceed the listed range, e.g., the S-400 Series SAMs have an advertised 250 nautical mile (nm) range.

Table 2-1. Typical Threat Weapons Capabilities (2005 to 2015)

Threat Category	Average Weapon Range	Used Against	Comments
Coastal Defense Cruise Missiles	50nm	Shipping including combatants, logistics units, and amphibious assault ships	effectiveness varies
Coastal Defense Artillery	15nm	Shipping including amphibious assault craft	generally inaccurate
Mines	<1nm	Shipping including amphibious assault craft	numerous types and capabilities
Patrol Boat/Ship Cruise Missiles	50nm	Shipping including amphibious assault craft	numerous types and capabilities
Submarine-Launched Cruise Missiles	50nm	Shipping including combatants, logistics units, and amphibious assault ships	numerous types and capabilities
Surface-to-Air Missiles	25nm	Manned aircraft, unmanned aerial vehicles (UAVs), loitering and sub-sonic cruise missiles	numerous types and capabilities
Ground Forces	<15nm	Ground forces, special operations forces	effectiveness varies
Tactical Ballistic Missiles	150nm	Airfields, ports, staging areas, amphibious objective areas	generally inaccurate
Directed Energy Weapons	<5nm	Manned aircraft, UAVs, loitering and sub-sonic cruise missiles	generally anti-sensor oriented, effectiveness varies
Radio Frequency Weapons	<5nm	Manned aircraft, UAVs, loitering and sub-sonic cruise missiles	generally designed to affect electronic systems
Information Warfare	N/A	Command and control networks, sensors and navigation systems	effectiveness varies widely
Air-to-Surface Missiles	50nm	Shipping including combatants, logistics units and amphibious assault ships. Also airfields, ports, staging areas, and amphibious objective areas	numerous types and capabilities

2.3 UNCONVENTIONAL LITTORAL THREATS

Potential threats will most likely use unconventional means against U.S. naval forces by taking advantage of the constraints imposed by rules of engagement and U.S. forces' adherence to the laws of war. Some rogue nations possess large numbers of fast, highly maneuverable, surface craft armed with crew served weapons and small arms that may conduct swarm attacks. Several potential rogue nations have large numbers of missile firing craft that could also engage friendly forces, generating multi-axis strikes in an attempt to overwhelm defenses. Commercial shipping can also be modified to carry hidden weapons similar to Q-ships[1] from World Wars I and II. Non-state actors may use similar craft and ships for attacks against friendly shipping and/or port facilities.

Rogue nations can also use commercial and general aviation aircraft as surveillance assets and potentially as weapons platforms or as remote controlled weapons. Non-state actors can use similar aircraft as weapons.

Several rogue nations, as well as non-state actors, are known to either possess or are actively seeking chemical, biological, radiological, nuclear, or explosive (CBRNE) agents and related material. The proliferation of CBRNE agents, the means of delivering them, and the expressed desire by several non-state actors to employ them to cause mass casualties suggests these agents may be used against U.S. naval forces in the future. In general, chemical or biological agents and radiological material are considered to be cheaper and easier to produce or acquire than nuclear weapons. Nevertheless, the seizure of special nuclear materials on the black market has lent new credibility to the nuclear threat as well. The combination of unconventional tactics, possibly including suicide attacks with CBRNE weapons, place U.S. naval forces operating in the littorals at increased risk throughout the timeframe of this document.

[1] Combatants disguised as noncombatant vessels. These ships appeared to be harmless until they were in a position to attack.

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3.0 REQUIRED CAPABILITIES AND EMPLOYMENT OBJECTIVES

This chapter addresses the required capabilities and employment objectives of naval fires within the context of the naval surface combatant.

3.1 INTRODUCTION TO FIRES

Fires is defined as the effects of lethal and nonlethal weapons. Joint fires are fires produced during the employment of forces from two or more components in coordinated action toward a common objective. Fire support is fires that directly support land, maritime, amphibious, and special operations forces to engage enemy forces, combat formations, and facilities in pursuit of tactical and operational objectives. Joint fire support consists of joint fires that assist land, maritime, amphibious, and special operations forces to move, maneuver, and control territory, populations, and key waters.[1]

Joint doctrine defines strike as an attack that is intended to inflict damage on, seize, or destroy an objective.[2] Broadly characterized, this definition encompasses all offensive actions that can be taken by air, naval, or ground forces to produce an effect (damage) on a defined objective. The naval services have refined this definition to narrow its scope in an attempt to differentiate between strike operations and fire support.

3.1.1 Subsystems of Fires

Fires is the synergistic product of three subsystems: target acquisition, command and control, and attack resources.[3]

- **Target Acquisition (TA).** The goal of the target acquisition system is to provide timely and accurate information to enhance the attack of specified targets. Target acquisition systems and equipment perform the key tasks of target detection, location, tracking, identification, classification, and battle damage assessment. This is further discussed in Chapter 7.
- **Command and Control (C2).** Employing command, control, communications, computers, and intelligence systems with unity of effort is key to effective coordination of fires, and includes the vertical and horizontal coordination accomplished by fire support coordinators, agencies and liaison elements. Successful C2 of fires integrates planning and coordination, technical and tactical fire direction procedures, and air operations to achieve the supported commander's desired effects. C2 is further discussed in Chapter 4.
- **Attack Resources.** Attack resources include air-to-surface, surface-to-surface, and subsurface-to-surface delivery assets. Fires also includes nonlethal and disruptive operations, such as psychological operations and electronic warfare. Detailed airspace and ground coordination is required regardless of the attack system employed. Coordination is further discussed in Chapter 6.

3.1.2 Naval Surface Fires

Naval surface fires must be fully integrated with the fires of all services to provide a full spectrum capability designed to unbalance and rapidly defeat an increasingly sophisticated, dangerous,

[1] Joint Pub 3-09, *Doctrine for Joint Fire Support*.
[2] Joint Pub 1-02, *Department of Defense Dictionary of Military and Associated Terms*.
[3] Joint Pub 3-09, *Doctrine for Joint Fire Support*.

and more complicated adversary. Often as the first on-scene force, surface combatants are capable of providing initial joint command and control of fires. When additional forces can be brought to bear, surface combatants will provide naval fires as part of a combined arms operations in joint campaigns.

Naval surface strike (NSS) has been defined in Chapter 1 as the destruction or neutralization of enemy targets ashore through the use of conventional weapons provided by surface combatants. These targets consist of strategic, operational, and tactical targets capable of conducting hostile operations against U.S. or Allied forces. These missions are characterized by attacks on strategic centers of gravity, war-making capacity, will to make war and military targets not directly in contact with friendly forces. NSS, usually conducted independent of ground maneuver forces, can generally be characterized within the joint fires framework as fires or joint fires.

Naval surface fire support (NSFS), also defined in Chapter 1, encompasses fires provided by Navy surface gun, missile, and electronic warfare systems in support of a unit or units tasked with achieving the commander's objectives. NSFS is usually associated with support of ground maneuver forces. Surface combatants tasked with providing NSFS must remain cognizant of the four basic tasks that are the focus of fire support plans: support to forces in contact, support the concept of operations, synchronize fire support, and sustain fire support operations. NSFS can generally be characterized within the joint fires framework as fire support or joint fire support.

Achieving rapid and decisive effects against our adversary will require a shift from our current sequential approach[4] to warfare. Future naval fires will support opportunities for simultaneous operations. The Navy will conduct strategic, operational and tactical fires throughout the littoral area that can be integrated with the direct insertion of highly mobile ground forces. Providing fires in support of simultaneous operations will require a fires system capable of providing the rapid application of integrated fires from dispersed formations throughout the battlespace. Achieving rapid, integrated fires requires a fully netted digital fires network capable of combining sensors, command and control, and fires.

Effective naval fires also require advances in existing support capabilities. These include at-sea replenishment, joint and coalition interoperability, data transfer, organizational adaptability, and training.[5]

3.1.3 Time Sensitive Targeting (TST)

Time sensitive targeting (TST) is a recently defined targeting and engagement process that is primarily being performed by air assets. Surface combatants with their improved land attack capabilities will also be able to conduct time sensitive engagements. TST has its foundation in *Joint Vision 2010*, from which the idea of precision engagement flows.

The current goal is to identify and effectively attack a target within 30 minutes (table 3-1). To achieve this goal requires an array of dedicated intelligence, surveillance, and reconnaissance (ISR) assets that have been organized in accordance with an intelligence preparation of the battlespace. The rules of engagement must facilitate rapid decision making by the commander or his battlestaff. The command and control systems must be technically capable of quickly disseminating targeting information to the engagement system. Time sensitive targets are further discussed in Chapter 7.

[4] This sequential approach begins with strikes against air defenses and military and industrial infrastructure sites and transitions to support of ground forces only after significant degradation to the adversary's capabilities.

[5] Detailed land attack warfare training requirements are provided in the *Training Requirements Document (TRD)*, dated 26 January 2001.

Table 3-1. TST Engagement Requirements

Goal: Attack fleeting mobile surface targets within 30 minutes

	Threshold	Objective
Confirm Identity	2 min	2 min
Weapon Selection / Engagement Order	3 min	3 min
Conduct Attack	25 min	15 min
Total	30 min	20 min

Definitions of Time Sensitive and Time Critical Targets[6]

Time sensitive targets (TST) are defined in Joint Publication 1-02 as "those targets requiring immediate response because they pose (or will soon pose) a clear and present danger to friendly force or are highly lucrative, fleeting targets of opportunity." Key factors include value, mobility, and time sensitivity.

Although not currently approved by joint doctrine, many joint commands use the term "time critical target (TCT)" as a sub-category of TST. These TCTs are deemed to pose such a threat to friendly forces that they are afforded distinctive ROE by the joint force commander (JFC). The JFC determines those situations, if any, where immediate engagement of the TCT threat outweighs other operational considerations.

Joint TCTs are normally based upon adversary capabilities. In other words, a joint TCT is a target of great immediacy that possesses such a significant threat to the joint force that it is specifically designated by the JFC for immediate engagement in order to prevent damage to friendly forces.

3.2 NAVAL SURFACE FIRE SUPPORT

3.2.1 Marine Corps Required Capabilities

The Marine Corps has formally stated its requirements for naval surface fire support in the document titled, *Naval Surface Fire Support Requirements for Expeditionary Maneuver Warfare.*[7] This section summarizes those requirements.

3.2.1.1 Sea-Based Fires as a Component of Combined Arms

Naval surface fire support augments the organic fires of the maneuver force with complementary, all weather fires that support the deep, close, and rear battle. The sea-based fire support system should include an all weather target acquisition capability that can produce target data for first round fire for effect. Further, a robust NSFS capability, to include counterfire detection/ engagement, is critical to support expeditionary operations during all stages of ship-to-objective maneuver.

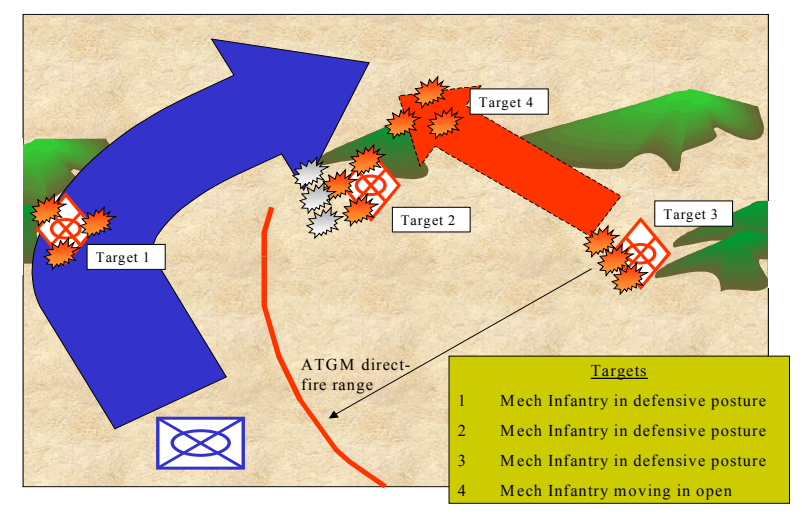
[6] *Commander's Handbook for Joint Time-Sensitive Targeting*, Appendix F, dated 22 March 2002.

[7] Commanding General (CG), Marine Corps Combat Development Command (MCCDC) letter 3900 C428, dated 19 March 2002.

Combined arms is the full integration of arms in such a way that to counteract one, the enemy must become more vulnerable to another. It pairs firepower with mobility to produce a desired effect upon the enemy. Marine Corps fire support doctrine is based upon this philosophy, whereby target destruction is frequently not the primary benefit of indirect fires.

Combined arms does not focus on specific percentages normally associated with damage criteria (e.g., 30% damage for destruction) but must concentrate on what fires can do to the enemy to shape the battlespace, set conditions for decisive action, and support maneuver. Fires can be used to create both some degree of hazard and the perception that the hazard is severe enough to merit deviation from a desired course of action. For example, if the enemy assumes a posture with the intent to protect himself from incoming fires he may sustain no physical damage but his cost of survival is the inability to perform his assigned mission.

In the following illustrative scenario, a friendly mechanized infantry unit encounters an enemy mechanized infantry unit arrayed in a defensive position that is tied in with the terrain. The defensive position lies between the friendly unit and its assigned objective, and bypassing the position is impossible. The unit commander decides to attack through the left flank and into the enemy's rear in an attempt to turn the position and pry the enemy out of his prepared defenses. Assuming an average rate of movement of 15 kilometers per hour, the attack will take a total of approximately 36 minutes. This rate of movement assumes that no counter-mobility obstacles will need to be breached, and that enemy indirect fire assets have been sufficiently suppressed to prevent any significant impact by these systems on the friendly force.



Fires have been planned to accomplish the following:

- Suppress Target 1 to facilitate its attack by direct-fire ground systems and rotary-wing close air support (RW CAS).
- Suppress and obscure Target 2 to prevent enemy force located there from effectively engaging friendly maneuver force with direct-fire weapon systems, and to facilitate its follow-on attack by friendly ground forces and RW CAS.
- Suppress, neutralize or destroy enemy at Target 3 to prevent it from maneuvering against the flank of the attacking friendly force, and to prevent it from counter-attacking (Target 4) as the friendly force continues to maneuver to its objective.
- Disrupt an enemy counter-attack from beyond the intermediate objective in the vicinity of Target 4 (on-call fire missions).

Fires involve more than the mere delivery of ordnance on target. The psychological impact on an adversary of volume and seemingly random fires cannot be underestimated. Marines applying the tenets of maneuver warfare will continue to exploit integrated fires and maneuver to shatter the cohesion of an adversary. **Volume and precision fires are equally important in achieving the desired effects on an enemy.**

3.2.1.2 Operational Phases

The following provides a breakdown of the phases of an expeditionary operation to facilitate placing NSFS requirements into context.

- **Shaping the Battlespace.** The emphasis in this phase will be on destruction, harassment, interdiction, and neutralization fires to degrade enemy capabilities within the battlespace. Naval fires are required for advance force and supporting operations in an uncertain or hostile environment. They will be used primarily for providing deep fires against critical fixed and relocatable targets.
- **Forcible Entry.** In this phase, emphasis shifts from shaping operations to supporting the force as it maneuvers to objectives ashore. This is the most demanding phase for NSFS. Deep fires provided by naval aviation and NSFS continue to shape the battlespace while simultaneously providing close supporting fires and counterfire to forces ashore. Of primary importance will be the close supporting fires (destruction, neutralization, and suppression) in direct support of the maneuver force. During ship-to-objective maneuver (STOM), fire support must provide immediate and responsive high volume fires in support of highly mobile forces as they maneuver throughout the non-linear battlespace.
- **Sustained/Subsequent Operations Ashore.** If the expected duration of the operation ashore warrants a general unloading of the landing force, organic ground-based fire support systems will provide the bulk of highly responsive, close supporting fires. NSFS will continue to provide deep and close supporting fires, augmenting organic ground-based systems.

3.2.1.3 Command and Control

Command and control (C2) for expeditionary fire support demands a system compatible with on-scene or arriving forces. Throughout the entire planning and execution process, all components of the expeditionary fire support system must be interoperable and collaborative. Given the joint nature of future operations, a re-examination of traditional command relationships is required to make these relationships more responsive and flexible. Central to an effective naval fire support system is that the commander responsible for the mission or for a phase of an operation, has the ability to plan, allocate, control, and coordinate fires from all available systems.

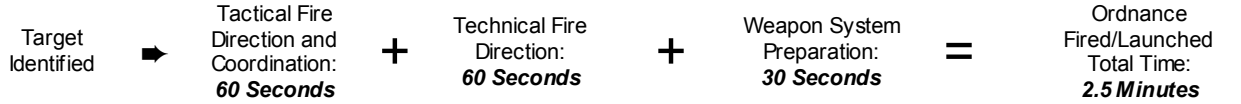
Commanders exercise authority within the four-dimensional limits of boundaries established by a higher headquarters. The commander has complete targeting and organic weapons release authority and is responsible for the effects of all fires delivered into or within these boundaries. Once these boundaries have been established, the command and control of fires is a function of the fire support coordinator within whose boundaries the effects of the fires will be realized. This includes coordination with adjacent units whose battlespace is affected by the flight path or terminal effects of the weapons system/ munition. NSFS controlling units support the airspace deconfliction process by providing weapons information, e.g., launch point and trajectory to the fire support coordination agency. This means that any adverse effects of NSFS delivered on a requested target are the responsibility of the requesting agency, not the commander of the ship who provided the fires.

3.2.1.4 Response Times

Ground forces require assistance in locating hostile fire support platforms in both the initial phases of amphibious operations and during subsequent operations ashore. A flexible and robust counterfire detection and location capability from the sea is a required component of the fire support system. The system should be responsive enough to achieve the first round away within 2.5 minutes of acquiring the counterfire target. The system must be fully interoperable and integrated with joint, automated, fire support C2 systems. Target acquisition will be accomplished from a combination of sensors netted together to provide the required area coverage.

The required system response times for all NSFS systems are drawn from the call for fire mission processing times specified for Marine Corps field artillery. Considering all mission types and all artillery munitions, the Marine Corps threshold requirement for NSFS execution responsiveness is 2.5 minutes. The objective requirement is to reduce response time to the limits of technology. The following diagram provides a breakdown of the fire support process with regard to responsiveness.

At extended ranges, time of flight can add minutes to the overall mission response time. A total mission time (call for fire to rounds on target) greater than 10 minutes significantly increases the probability of missing a relocatable target. Minimizing time of flight, as well as the total mission processing time is of vital importance when providing close supporting fires to maneuver forces in contact with the enemy.



3.2.1.5 Sustainability

Maneuver forces require all-weather, reliable, sustained fire support. Per the *Surface Combatant Land Attack Warfare Guidance Document* signed by Rear Admiral Mullen on 11 September 2000, "Replenishment at sea is sustainment." The current technical difficulties of reloading vertical launch system (VLS) cells at sea requires an increased reliance on shore based infrastructure. The availability of friendly ports for reloading VLS cells cannot be counted upon in a highly uncertain future. The limitations of a shrinking surface fleet and the numerous taskings given to multi-mission capable ships will require that those ships assigned to NSFS roles possess greater staying power to continue support of forces ashore. The rapid conduct of ammunition resupply is an essential enabler to maintain continuous fire support. Sustainability is discussed in greater detail in Chapter 8.

3.3 NAVAL SURFACE STRIKE (NSS)

Naval surface strike is a subset of strike warfare, which also includes air strike, special operations, and subsurface strike. NSS missions are designed to attack targets that comprise an adversary's capacity to wage war, and to interdict enemy reinforcements and isolate these reinforcements from the battlefield.[8] Currently, the Tomahawk missile is the only long-range weapon available to the surface combatant to perform NSS. The Tomahawk's accuracy has often made it the weapon of choice relative to other strike assets when collateral damage is a significant concern. Future weapons (such as the advanced gun system) and munitions (such as

[8] NWP 3-09.1, *Navy Strike and Fire Support* (Draft), dated 6 February 2002.

extended range guided munition, long range land attack projectile, and advanced land attack missile) will dramatically expand the choice of weapons available to perform NSS.

The basic requirements of NSS are as follows:[9]

- Provide a conventional capability against tactical, operational, and strategic targets during crisis response, regional conflicts, or a major theater war.
- Respond to a broad range of desired terminal effects to include destruction, neutralization, interdiction, and suppression.
- Destroy or neutralize enemy targets through the use of coordinated, precision strike weapons.
- Deliver timely effects on target regardless of environmental conditions or time of day.
- Engage time critical targets.

3.4 MANPOWER, PERSONNEL, AND TRAINING

We can no longer afford to generate requirements or design systems without considering the impact on operator and decision maker performance and on the ability of battle groups and amphibious ready groups to train and operate in a joint battlefield environment. Today, responsibility for land attack warfare systems design and acquisition is spread across several program executive offices and program management offices in Naval Sea Systems Command, Naval Air Systems Command, and Space and Naval Warfare Systems Command. The signatories of the memorandum of agreement establishing the Land Attack Warfare Capstone Organization understand that while each land attack program is managed in response to individual requirements funding, unless coordinated, there is potential to produce systems which will not meet the tests of joint and fleet interoperability, compatibility, and supportability. Developed in isolation, any or all of these land attack warfare systems will likely result in inefficient use of scarce resources and incur higher life cycle costs.

We must not design and field individual systems without considering from day one the impact they will have on our ability to train for and execute the full spectrum of land attack operations, from an individual sailor's ability to operate and/or maintain specific pieces of equipment to the conduct of joint operations. In short, we must fundamentally change our cultural perspective on manpower, personnel, and training through consistent application of the principles of human systems integration (HSI) to achieve optimal manning and better mission training. Our ability to effectively and successfully employ land attack warfare system will directly reflect out commitment to these principles and processes across all land attack warfare programs.

Navy ships and attendant combat systems are complex and present enormous HSI challenges. As a matter of routine, ships prepare for and operate in all weather and climates conducting multiple and simultaneous operations quite possibly in a multi-warfare environment with systems manned and operated by crews determined by diverse personnel and manning plans. Performance demands, including those placed on these sailors by the design of complex combat systems, are unique in the breadth of their scope and the depth of their complexity. Navy ship systems employed in the fleet today, and those being designed for future operations, make intense demands on the readiness, performance effectiveness, and mental and physical capabilities of the personnel who man them. Specifically, many of these systems are extremely demanding on the senses. They will demand that the operators develop improved motor and cognitive skills, as well as better decision making and situational awareness. Add the highly varied nature of the threat, the need to conduct multi-warfare scenarios, and the need to

[9] Derived from the *Surface Combatant Family of Ships DD(X) CRD* (Draft) (U).

integrate, coordinate, and interpret information from multiple sources. Without adequate design and support, mission risk increases and responsiveness decreases due to high workload and mission demands.

Department of Defense and Department of the Navy acquisition directives mandate that HSI initiatives be pursued to optimize total system performance and minimize total ownership costs by ensuring systems are built and employed to accommodate human performance characteristics. Accordingly, it is imperative that in development of a land attack warfare concept of operations and, in particular tactics, techniques, and procedures (TTPs) for land attack warfare systems, human performance be given top priority. Land attack warfare systems CONOPS and TTP requirements must be developed in close collaboration with all individual land attack warfare programs to identify commonalities, merge requirements, and avoid duplication. Particular attention should be given to the identification of operator tasks in order to reduce workload, facilitate situational awareness, and enhance decision making.

Systems should be designed to facilitate and support supervisory control – that is user supervision of "smarter" automated systems. Workload should be reduced or eliminated, particularly with regard to data input and manipulations done between non-congruent land-attack system components. A "system of systems" in land attack warfare is needed which produces quality and concise task products which personnel can approve or edit quickly. This result will facilitate mission execution speed and accuracy, with consistency across land attack warfare platforms. The design and production of such systems begins with thorough task and procedural analysis, and uses human factors engineering to apply quality design solutions that are tested in an iterative manner with fleet personnel.

Required operator functions/tasks must be adaptable to various training configurations inport and underway, single and multi-ship, and scalable to distance learning. These functions/tasks must ultimately be integrated into training systems that will provide operators with (1) a synthetic training environment, (2) a merged environment of live data augmented by synthetic information, and (3) segregated live and synthetic training capability to support individual and team training.

The *Surface Combatant Land Attack Warfare Training Requirements Document (TRD)*, was approved 26 January 2001 by the Land Attack Capstone Flag Level Steering Committee. It states the requirements of mission area training and provides specific guidelines to program managers for the integrated development of land attack warfare mission area training capability. The Draft Revision 1 to the TRD contains a separate chapter on HSI requirements including guidance on applying HSI for the four acquisition scenarios. Brief descriptions of HSI methodologies/ tools are also provided. The TRD provides the foundation for ensuring that future surface navy sailors are appropriately selected and trained to accomplish land attack warfare.

4.0 COMMAND AND CONTROL

This chapter provides an overview of the command and control issues associated with conducting surface combatant land attack missions. It also presents examples of the flow of command and control information in each of the five surface combatant roles.

4.1 INTRODUCTION

This chapter sets forth general and specific guidance regarding command and control (C2) functions as they apply to surface combatants conducting naval fires operations. It begins with a summary of several factors and considerations affecting C2, and then provides an overview of the joint and naval organization and structure within which surface combatants operate. It covers the various types of command relationships with emphasis on the supporting and supported relationships that could be most common and relevant for surface combatant commanding officers. The command relationships discussion is followed by a summary table of the inherent responsibilities of a surface combatant in each of the five surface combatant naval fires roles.

The final section of the chapter presents specific illustrative examples, to include detailed diagrams, of how a fire mission would be processed in each of the five roles. These examples were developed during the workshop referred to in Chapter 1.[1]

[1] The October 2001 workshop examined four specific tactical situations, each highlighting one or more surface combatant roles. The primary goal was to trace the flow of command information required to deliver fires in each specific situation to develop generalized conclusions regarding command and control of fires. A secondary goal was to develop operational sequence diagrams (OSD) that depict the agencies involved in conducting fire missions and to highlight the actions that would be performed. Section 4.5 provides a detailed discussion of the four OSDs.

4.2 FACTORS AND CONSIDERATIONS

The organization, structure, and command relationships are normally established by a common superior commander or establishing authority based on mission, nature, and expected duration of the operation, forces available, force capabilities, C2 capabilities, battlespace assigned, and recommendations from subordinate commanders.

The increased capabilities of naval surface fire support (NSFS) and naval surface strike (NSS) weapons, the demands for shorter response times, and the added complexity of future command and control systems suggest a re-evaluation of the organization, structure, and command relationships and the many factors and considerations involved. A notional C2 structure for the future is presented in section 4.3.

4.2.1 Definition

Command and control (C2) is the exercise of authority and direction by a properly designated commander over assigned and attached forces in the accomplishment of the mission. C2 functions are performed through an arrangement of personnel, equipment, communications, facilities, and procedures employed by the commander in planning, directing, coordinating, and controlling forces and operations in the accomplishment of the mission.[2]

[2] Joint Pub 1-02, *DOD Dictionary of Military and Associated Terms*.

Command and control responsibilities extend beyond direct control of forces and weapons to include the coordination of various weapons throughout the battlespace. This control and coordination not only creates the desired effects on the enemy through the decisive and combined use of firepower, but also avoids physical conflict between weapons or delivery systems, and prevents friendly casualties. Coordination is discussed in greater detail in Chapter 6.

4.2.2 Rules of Engagement (ROE)

Rules of engagement (ROE) are the directives issued by competent military authority which delineate the circumstances and limitations under which United States forces will initiate and/or continue combat engagement with other forces encountered. ROE implement the inherent right of self-defense, define use of force for mission accomplishment, and apply throughout the spectrum of conflict. New systems will enable fast, efficient command and control to be exercised from any level, tactical through strategic. Commanders may have access to a much broader array of weapons. Consequently, the ability to rapidly amend ROEs, to include guidance on weapons release authority, will become increasingly important.

4.2.3 Establishing Directive

A superior commander establishes support relationships between subordinate commanders when one organization should aid, protect, complement, or sustain another force. A support relationship is often appropriate for amphibious operations or on other occasions when surface combatants are supporting ground forces.[3] An establishing directive is normally issued to specify the purpose of the support relationship, the effect desired, and the scope of the action to be taken. It should identify responsibilities for strike planning and execution, and fire support planning and coordination among commanders involved in the support relationship (e.g., an amphibious operation). The role of a surface combatant may change throughout the course of the operation, as it moves from first on scene to part of a larger force, shifting between strike and fire support missions. The establishing directive must support these changing roles by articulating clear, responsive command relationships, NSFS/NSS priorities, and procedures for conflict resolution.

4.2.4 Task Organization

Task organization establishes the supporting and supported relationships essential to creating unity of command, synchronizing operations, preventing fratricide, and maximizing the effects of fires. The organization of forces, especially in a joint environment, directly affects command and control, responsiveness, and versatility during land attack operations. Forces are organized based on mission, commander's vision, and overall concept of operations. Other factors include forces available, unity of effort, and provision for centralized planning and decentralized execution. Centralization of key functions should not restrict the versatility, responsiveness, and initiative of subordinate forces. Sophisticated command and control networks and the increased range and accuracy of weapons provide commanders access to a broad array of forces and weapons systems from outside the operations area. This ready access blurs the distinct lines that once separated forces assigned to surface strike from those assigned to fire support. For example, a surface combatant may be tasked to execute a strike mission while performing a fire support mission. The command and control systems, both internal and external to the ship, should be able to accommodate this situation.

[3] See Joint Pub 3-02, *Joint Doctrine for Amphibious Operations*, for a detailed discussion of command relationships in amphibious operations.

4.3 ORGANIZATION AND STRUCTURE

Surface combatants are elements of the joint and Navy operational command organizations (figure 4-1). The unified theater combatant commander designates joint force or joint task force commanders (JFC/JTFC) to conduct sustained operations or campaigns. Offensive naval forces organized into carrier strike groups (CSGs), surface and submarine strike groups, and expeditionary strike groups (ESGs) will be assigned to a joint force maritime component commander (JFMCC).

Surface combatants will operate as elements of all of the above naval groups. For either surface strike or fire support missions, surface combatants will be tasked to coordinate with and/or respond to naval and joint force fires agencies.

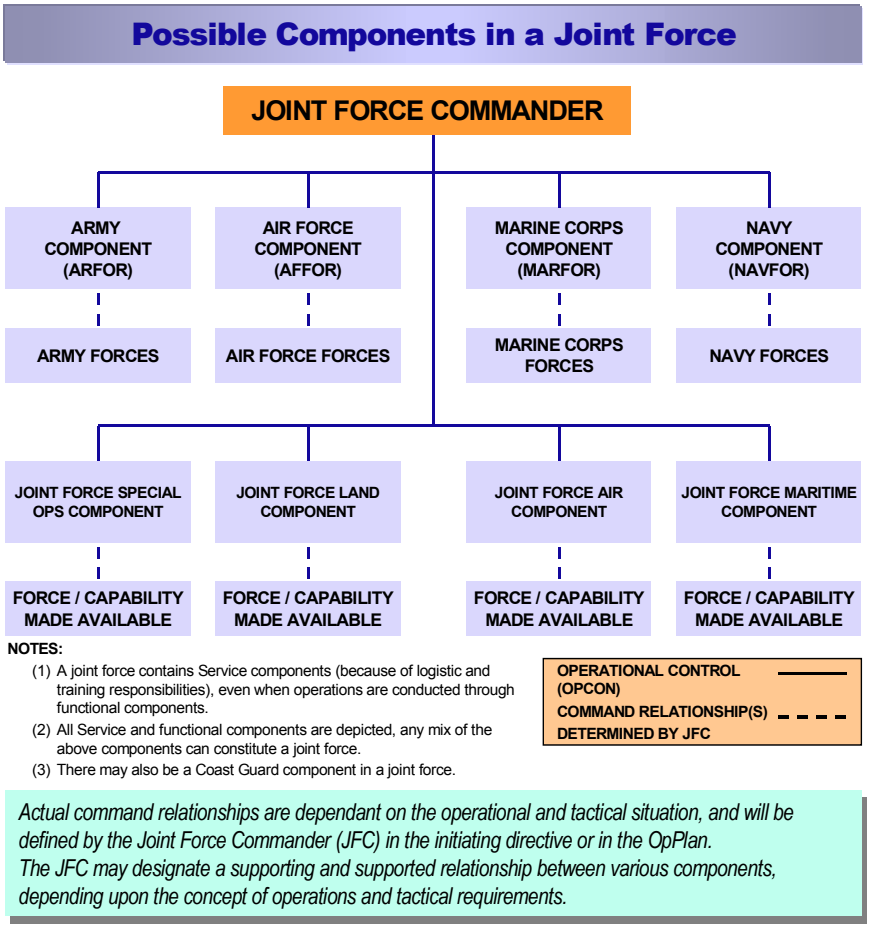


Figure 4-1. Notional Command Structure for a Joint Operation

4.3.1 Notional External Command and Control Organization

Figure 4-2 depicts the notional command and control structure for surface combatants in the execution of NSS or NSFS missions. The JFMCC has operational control of one or more naval elements [CSG, surface action group (SAG), or ESG] that include individual surface combatants. Naval fires coordination agencies, such as the supporting arms coordination center (SACC), force fires coordination center (FFCC), fire support coordination center (FSCC), Tomahawk strike coordinator (TSC), Tomahawk launch area coordinator (LAC), and others exist within the framework of the Navy's traditional command and control structure. The command elements have operational control over the surface combatants, but the fires from the surface combatants, both NSS and NSFS, are controlled through the naval fires coordination agencies. Strike agencies, the TSC and the LAC, coordinate with fire support agencies, SACC, FFCC/FSCC, etc., to prevent conflict and to enhance the mission effectiveness. The naval fires coordinator (NFC)[4] as proposed in this document, would have overall responsibility for coordinating both NSFS and NSS missions.

[4] NFC is more fully defined in Chapter 6.

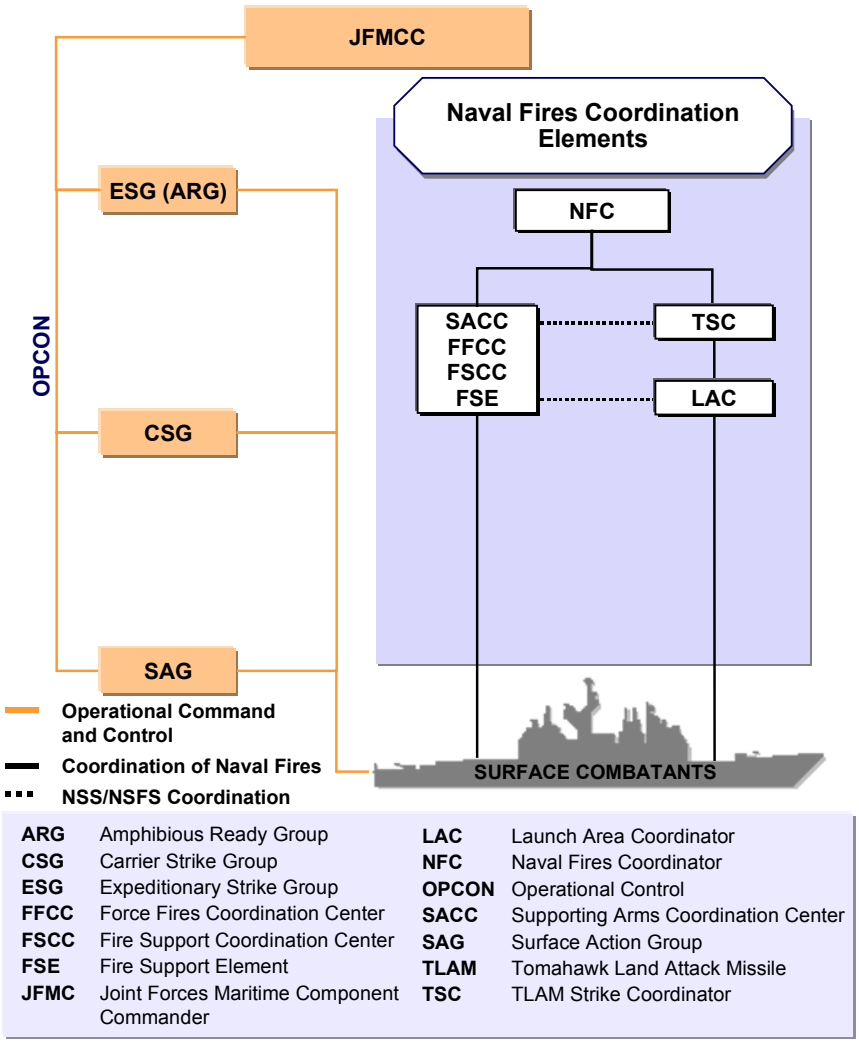


Figure 4-2. Notional Command and Control Structure

4.3.2 Internal Shipboard Organization

On Aegis equipped surface combatants there is currently no requirement to integrate the existing Aegis weapon system and the new naval fires capabilities.[5] Additionally, although the same operator working at the same console will conduct strike and naval gunfire support functions, these functions will be performed independently. The notional naval fires command and control structure presented in figure 4-2 may require adjusting the duties and responsibilities that currently exist within the combat information center (CIC) in order to support evolving NSS and NSFS capabilities. To optimize transparency of fires, the future combat system functions must be integrated, interoperable, and collaborative, facilitating control and awareness of all shipboard fires functions by systems operators, supervisors, and battle watch staff. The ship's commanding officer must be able to maintain situational awareness over the multi-warfare tactical picture, resolve resource conflicts, manage weapons and fire control, and ensure compliance with commander's guidance and ROE.

[5] Desirabilty of integrating is well recognized by OPNAV, but has not been funded due to fiscal constraints.

4.4 COMMAND RELATIONSHIPS

The naval component commander exercises operational control through the numbered fleet commanders or other subordinate task forces. These forces are task organized as battle forces, task forces, task groups, task units, and task elements composed of individual units necessary to accomplish specific operational missions. The officer in command of any of the task organizations is designated as the officer in tactical command (OTC) and has primary responsibility for executing that may create as many task groupings as necessary, assigning OTC responsibilities as deemed appropriate. The naval component commander retains critical theater level perspective on naval operations. To facilitate execution and establish combat responsibilities the Navy uses a C2 arrangement referred to as the composite warfare commander (CWC) concept integrating ships, submarines, aircraft, and land based forces.

The Navy employs the CWC concept as the doctrinal cornerstone of its task force operational and tactical C2 system. The CWC concept enables the OTC of a naval force to conduct combat operations in functional areas against air, surface, subsurface, and land threats while contributing to the overall campaign of the JFC. The CWC uses OPGENs[6] to set actual at-sea arrangements for operational control, tactical control, supported, and/or supporting relationships.

Overview of Composite Warfare Commander (CWC) Doctrine and Organization *(NWP-3-56 (Rev. A), Chapter 2)*

CWC Doctrine

The CWC doctrine embodies a basic organizational structure that is responsive to the demands of modern Naval warfare and provides a body of operational principles with associated supporting procedures. Use of this doctrine enables the Officer in Tactical Command (OTC) to wage offensive and defensive combat operations aggressively against air, surface, undersea, and land-based threats while carrying out the primary mission of the force. The OTC may implement CWC procedures whenever and to whatever extent required depending upon the composition and mission of the force and the nature and severity of the threat. Flexibility of implementation, reinforced by clear guidance to subordinates, is the key element of this doctrine.

The CWC doctrine offers a methodology for effective decentralized C2 by recognizing that the magnitude of some threat scenarios requires dividing up the C2 work among several commanders to achieve effective spans of control. The CWC doctrine also recognizes that timing or communication limitations may not allow commanders and units to seek and obtain clearance from their seniors before responding to certain threats. A negative aspect of decentralized C2, however, is the risk of improper execution of policies and misinterpretation of guidance from higher authority.

CWC Command Organization

The OTC will always be responsible for accomplishing the mission of the forces assigned. He may delegate authority for the execution of various activities in some or all warfare areas to designated subordinate warfare commanders. The OTC is normally the CWC. However, the CWC concept allows an OTC to delegate tactical command (TACOM) to the CWC. The CWC would exercise TACOM of the Principal Warfare Commanders who include Air Defense Commander (ADC), Antisubmarine Commander (ASWC), Information Warfare Commander (IWC), Strike Warfare Commander (STWC) and Surface Warfare Commander (SUWC). The CWC is also over the Functional Warfare Commanders such as the Mine Warfare Commander (MIWC) and Screen Commander (SC) as well as asset and resource Coordinators such as the Airspace Control Authority (ACA), Launch Area Coordinator and TLAM Strike Coordinator (TSC). The warfare commanders are responsible for collecting and disseminating information and, in certain situations, are delegated the authority to respond to threats with assigned assets. The CWC command structure is highly flexible with the OTC assigning forces and authority based on the specific requirements of the situation.

[6] Stands for operational general matters and is a message format within the maritime tactical messages system, a standardization of Navy general operating instructions, NWP 5.

4.4.1 Operational Control (OPCON)

OPCON is the authority to perform those functions of command over subordinate forces involving organizing and employing forces assigning tasks, designating objectives, and giving authoritative direction necessary over all aspects of military operations and joint training necessary to accomplish missions assigned to the command.[7] OPCON may be delegated to and exercised by commanders at any echelon below the level of combatant commander, however, it would be more frequently exercised at echelons higher than the individual surface combatant.

4.4.2 Tactical Control (TACON)

TACON is the command authority over assigned or attached forces or commands or military capability made available for tasking that is limited to the detailed direction and control of movements or maneuvers within the operational area necessary to accomplish assigned missions or tasks.[8] TACON is inherent in OPCON and may be delegated to and exercised by commanders at any echelon at or below the level of the theater commander. TACON is the most likely command relationship for the surface combatant NSFS controlling unit or the NSS multi-unit commander role.

4.4.3 Support[9]

Support is a command authority appropriate when one organization should aid, protect, complement, or sustain another force. The support command relationship is especially relevant to amphibious operations. For example, the establishing authority in an amphibious operation defines a support relationship between commanders within the amphibious force as well as other designated commanders as appropriate. The support relationships are intentionally flexible. The establishing authority will specify the purpose of the support, the desired effect, and the scope of action to be taken.

4.4.3.1 Supported Commander

The supported commander has the authority to exercise the general direction of the supporting effort. General direction includes the designation and prioritization of targets or objectives, the timing and duration of the supporting action, and other instructions necessary for coordination and efficiency. A supported commander may be designated for the entire operation, a particular function, or a combination of phases, functions, or events. If the operation is relatively short, the establishing authority may select one supported commander for the entire operation.

4.4.3.2 Supporting Commander

The supporting commander determines the forces, tactics, methods, procedures, and communications that will be used to provide the support. He will advise and coordinate with the supported commander on the employment and limitations of support, assist with planning, and ensure the supporting units are fully aware of the supported commander's needs and intent.

4.4.3.3 Supporting and Supported Relationships in Joint Environments

The land and naval force commanders are the supported commanders within their areas of operations (AOs) designated by the JFC. Within these AOs, the supported commanders have the authority to designate target priorities, munitions effects, and the timing of weapons delivery to

[7] JP 0-2, *Unified Action Armed Forces (UNAAF)*, dated 10 July 2001, pp. III-7, 8.
[8] Ibid, p. III-8.
[9] Ibid, pp. III-9, 10.

best synchronize maneuver and fires. The JFC also has the authority to establish priorities that will be executed throughout the theater or joint operations area (JOA), including within the land and naval force commanders' AOs. Commanders designated by the JFC have the latitude to plan and execute these JFC prioritized operations and attack targets within land and naval AOs, but they must be coordinated with the land and naval force commanders.

4.4.4 Transfer of Command and Control

Surface combatants must be able to smoothly transition from one role[10] to another.

In response to a developing crisis, first on the scene surface combatants can operate independently until follow-on forces can be dispatched to the operating area. Operating in the NSS single unit role, the ship must be able to provide for the ship's self defense and employ its land attack capability. If the conflict widens and additional surface combatants arrive on scene, the senior commanding officer may be assigned as the NSS multi-unit commander to commence attacks against the enemy.

During amphibious operations, a surface combatant normally begins in a NSFS supporting unit role and receives orders to fire from the SACC. As the operation progresses, the surface combatant may assume the NSFS controlling unit role if the SACC transfers authority for tactical fire direction over other surface combatants.

The surface combatant must be interoperable with joint forces when they arrive on scene. Upon arrival of a more senior commander, the combatant will transfer command and control functions as directed. Joint interoperability and connectivity of command and control systems must be achieved for surface combatants to operate effectively in the land attack roles.

[10] See Chapter 1 for definitions of the five roles.

4.4.5 Liaison Elements for Land Attack

With the evolution of the surface combatant's land attack mission area, NSFS and NSS missions will be conducted in support of operations that have not historically included fires from surface combatants as key elements of the associated fire plans. Therefore, the need for effective liaison between the supported and supporting forces becomes more important as the capability of naval fires increases.

For NSFS, the traditional Navy and Marine Corps doctrine, procedures, and organization for naval gunfire support provide for liaison between surface combatants and the supported units. Key to effective liaison is the staffing of doctrinal billets[11] and the training of surface warfare officers in land attack warfare.

The current liaison structure and training for naval gunfire support may not be sufficient to respond to the expanded capabilities of both NSFS and NSS. New land attack weapons systems (e.g., ERGM and TACTOM) have flight profiles significantly different than traditional naval gunfire and require more extensive coordination than has been performed in the past by the naval gunfire liaison officer. This coordination could be effected through the establishment of a new coordination detachment within the JFACC.

This document recommends the establishment of a naval coordination detachment (NCD)[12] as identified above and described in Appendix C. The NCD would provide on-site representation within the JFACC regarding surface combatant land attack matters.

[11] Naval gunfire officers and naval gunfire liaison officers. (Note: these titles should be changed to reflect the broader function of naval surface fires; e.g., NSF officer and NSFLnO.)

[12] The NCD expands on the responsibility of the naval and amphibious liaison element (NALE) as described in draft NWP 3-09.1 and could be included within or replace the NALE.

The presence of Army and coalition forces involved in land attack warfare presents additional challenges. The elimination of the air and naval gunfire liaison companies (ANGLICOs) from the active Marine Corps force structure reduced the liaison support capability naval forces can provide to the U.S. Army and coalition forces.[13] Recognizing the value that ANGLICO added to the joint force, the Marine Corps has decided to re-activate ANGLICO in both I and II Marine Expeditionary Forces (MEFs). These active component liaison companies will become operational in 2003.

The range and precision of new land attack weapons makes them also relevant to Army operations. The Army may find it necessary to develop a liaison structure that will enhance its ability to operate with supporting surface combatants. For example, the Army could embark a liaison team onboard a surface combatant in a controlling unit role, with the necessary equipment to support an Army operation.

Special operations forces (SOF) interoperability with supporting surface combatants may require a SOF liaison detachment[14] on the ship. The two main functions of the SOF detachment would be: (1) to provide or advise on communications with supported SOF units, and (2) to advise the ship's commanding officer regarding any special considerations for the employment of land attack weapons in support of SOF units.

4.4.6 Inherent Responsibilities for Surface Combatants

Surface combatants operate in one of the five roles described in detail in Chapter 1. Each role requires the surface combatant to perform specific functions and assume certain responsibilities. Shipboard command and control responsibilities must be clearly defined. The surface combatant and the agency or unit being supported must have the same understanding of those functions and responsibilities. To prevent confusion, minimize excessive voice communications, and increase mission responsiveness, a set of common practices or *inherent responsibilities* specifies a surface combatant's functions and relationships with higher headquarters and supported units. These responsibilities will vary, depending on the surface combatant's role. Table 4-1 is based on an artillery model[15] and summarizes the inherent responsibilities for surface combatants in a matrix format. It addresses several issues unique to surface combatants that:

- operate in firing areas vice a specific geographic location,
- have multi-warfare ship self-defense responsibilities,
- have multi-warfare sensor capabilities,
- are responsible to the battlegroup commander for other mission areas, and
- have different command relationships.

The inherent responsibilities define standard tactical support responsibilities for each role to facilitate task organization, improve communications, and reduce the need for detailed coordination.

The matrix defines these responsibilities regarding priority of fires, zones or areas of responsibility, targeting sources, communications, fire planning, and sensor allocation.

[13] Two ANGLICOs were maintained in the Marine Corps Reserve.

[14] The SOF liaison detachment could consist of a single liaison officer with appropriate communications.

[15] Joint Pub 3-09, *Doctrine for Joint Fire Support*, Appendix B, Fire Support Missions, dated 12 May 1998.

Table 4-1. Inherent Land Attack Responsibilities for Surface Combatants

A Ship with a Role of …	NSFS Supporting Unit Role	NSFS Controlling Unit Role	NSS Single Unit Role	NSS Multi-Unit Commander Role	NSS Firing Unit Role
Answers tasking in priority from…	1. Supported unit 2. Higher HQ	1. Supported unit 2. Higher HQ	Higher HQs via LAC/TSC/ JAOC/STWC, etc.	Higher HQ via LAC/TSC/ JAOC/STWC, etc.	1. Multi-ship commander 2. Higher HQ via LAC/TSC/ JAOC/STWC, etc.
Has as its zone of fire…	Zone of action of supported unit	Zone of action of supported unit	Area of action defined by higher HQ	Area of action defined by higher HQ	Area of action defined by higher HQ
Receives targeting from …	Supported unit (FO/FSCC/FSE/ SACC)	1. Supported unit (FO/FSCC/FSE/ SACC) 2. Organic targeting assets	1. Organic targeting assets 2. Sensor grid (reachback)	1. Organic targeting assets 2. Sensor grid (reachback)	1. Multi-ship commander 2. Organic targeting assets 3. Sensor grid (reachback)
Establishes communications with…	1. Supported unit (FSCC/FSE/ SACC) 2. Controlling unit	1. Monitors FS net 2. Supported unit (FSCC/FSE/ SACC)	1. Higher HQ 2. Monitor strike net[16]	1. Higher HQ 2. Monitor strike net	1. Multi-ship commander 2. Higher HQ 3. Monitor strike net
Has fires planned by…	Supported unit	Supported unit	1. Own ship 2. Higher HQ	Higher HQ	1. Multi-ship commander 2. Higher HQ
Allocates assigned sensors in priority for use by…	1. Supported unit 2. Controlling unit 3. Own ship	1. Supported unit 2. Own ship	1. Own ship 2. Higher HQ	1. Higher HQ 2. Own ship	1. Multi-ship commander 2. Higher HQ 3. Own ship

The following situation illustrates the importance of standard inherent responsibilities:

Several surface combatants are assigned the *Supporting Unit* role to a Marine Expeditionary Brigade (MEB). Based on table 4-1 the ships would:

1. **Answer fires tasking in priority from** the MEB (supported unit) and also answer any tasking from higher HQ.
2. **Have its zone of fire** determined by the MEB.
3. **Receive targeting from** the supported unit (FFCC/SACC (ashore/afloat)). Targeting may also be provided directly by forward observers assigned to MEB maneuver units.
4. **Establish communications with** the supported unit (FFCC/SACC) or as assigned.
5. **Have fires planned by** MEB (FFCC/SACC). This means pre-planned fires will be provided to the ships for scheduling and execution as directed by the supported unit. For example, the FFCC/SACC sends information to the ships that includes target data, weapons/munitions data, and timing data for schedules of fire. The ships would process and prepare the schedule of execution on the pre-arranged timeline.
6. **Allocate assigned sensor resources** in response to MEB targeting priorities**.**

[16] The Tomahawk strike network (TSN) may serve as the backbone of this broader strike network.

4.5 COMMAND AND CONTROL (C2) WITHIN THE ROLES

The section sets forth a specific situation for each of the five roles (note: section 4.5.4 includes two roles) and uses narrative and associated operational sequence diagrams (foldout figures 4-7, 4-8, 4-9, 4-10) to describe how a fire support or strike mission could be prosecuted in that situation.

Symbols used in figures 4-3 through 4-10 are taken from FM 101-51/MCRP 5-2A, *Operational Terms and Graphics* which is in compliance with MIL-STD-2525A.

4.5.1. Naval Surface Fire Support Supporting Unit Role: *Amphibious Operation, Call for Fire*

4.5.1.1 Special Situation *(see figure 4-3)*

An amphibious task force (ATF) has been deployed to Country ORANGE to conduct an amphibious assault. The mission of the ATF is to prevent enemy occupation of the vital port and industrial complex in Country ORANGE to facilitate the reception of follow-on forces in theater. A lead battalion of an enemy motorized rifle regiment is located 16 km east of RED Beach. Enemy forces are consolidating their positions and displacing logistics forward. Indications are that the enemy will move to occupy the port and industrial complex (10 km west of RED Beach) within the next several days.

Battalion landing team, 2nd Battalion, 1st Marines (BLT 2 / 1) is an assault battalion of the landing force. Its mission is to attack across RED Beach 1 at 0600, D-Day, to seize Division Objective 1 and establish a blocking position to prevent the movement of enemy forces along Route 15, into the port and industrial complex.

The BLT 2 / 1 commander's intent is to conduct a surface assault across RED Beach 1 with two companies abreast, avoid decisive engagement on or near the beach, and move swiftly inland to seize the high ground, in zone, which dominates Route 15.

At 0530, thirty minutes before H-Hour, a reconnaissance team on Hill 300 observes an estimated platoon sized enemy mechanized unit (with two ZSU-23 / 2 twin towed AA systems) in the vicinity of Hill 84 on the left flank of BLT 2 / 1's axis of advance. Informed of this development, the BLT 2 / 1 commander decides not to alter his scheme of maneuver, but to try to neutralize the enemy unit by fire and bypass. If that fails, he would have his left flank company (Echo Company) block the enemy advance while his right flank company (Fox Company), and reserve company (Golf Company) move swiftly to seize the objective.

The BLT 2 / 1 commander notifies the Echo Company commander of the threat. He reminds the Echo Company commander that attack helicopters are on station and available to attack the enemy mechanized forces, but that the ZSU-23s need to be suppressed before the helos go in.

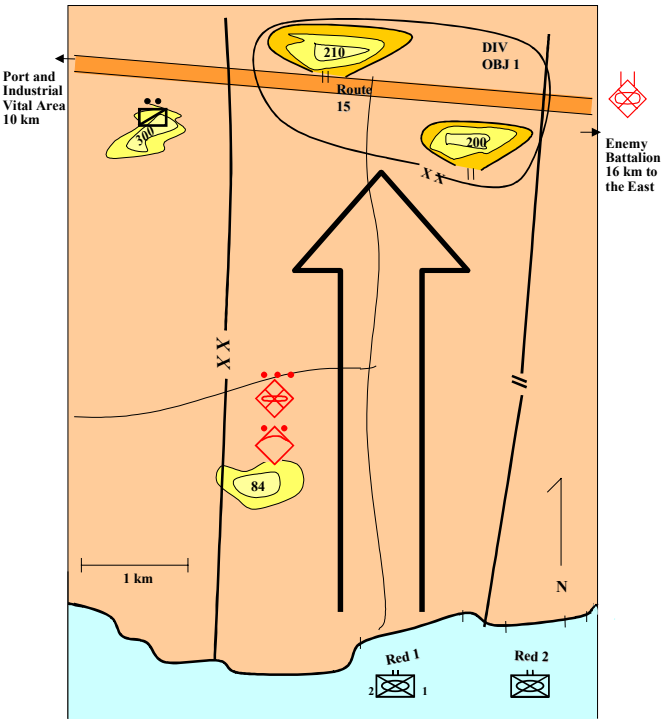


Figure 4-3. Amphibious Operation

The Echo Company commander immediately briefs his platoon commanders, his forward air controller, and his NSFS Spot Team of the situation. He directs the NSFS Spot Team, which is equipped with TLDHS, to strive for first round accuracy in the suppression mission not only to prevent effective employment of the weapons, but also to hinder their displacement to new firing positions before the attack helicopters can complete their attack on the enemy mechanized forces.

4.5.1.2 Assumptions

- The amphibious force is a Marine Expeditionary Brigade / Amphibious Ready Group (MEB / ARG).
- Command is afloat and the Commander, Amphibious Task Force (CATF) is the supported commander.
- An amphibious objective area (AOA) has been established and is bounded by a ceiling altitude as delineated by the air control plan.
- The tactical air control center (TACC), which is automated and co-located with the SACC, exercises airspace control within the AOA.
- The airspace control authority (ACA) is the JFACC for the overall joint operations area.
- The SACC has been equipped with an automated fire support and mission planning system, the core of which is the advanced field artillery tactical data system (AFATDS).
- The primary mission of the surface combatants is fire support.

4.5.1.3 Sequence of OSD Events

(See operational sequence diagram (OSD), figure 4-7, at the end of this chapter; time sequence indicators below (T_n) correspond to the time sequence numbers on the OSD)

T_0 The NSFS Spot Team with Echo Company, equipped with a TLDHS, accurately locates and designates the target and generates a fire request (FR). The data communication path is via SINCGARS radio, which interfaces with the DACT component of the TLDHS, via relay to the automated fire support system terminal located in the SACC. The FR data is also provided, via internal LAN, to the AFATDS also located in the SACC. The AFATDS updates the databases of all AFATDS ashore once they are able to receive data transmissions.

T_1 The AFATDS in the SACC processes the FR by performing the following functions: target processing, target filtering, attack analysis, and mission execution. A summary of the functions of the automated fire support system in the SACC is described below:

During **target processing**, the FR is received and a verification of sufficient target data is performed. If required data is missing from the FR, the AFATDS operator may manually insert the missing data fields. A target number is assigned and the FR is compared against target selection standards established as part of commander's guidance.

During **target filtering**,[17] the target data is contrasted against the existing target list to check for duplication. A no-later-than (NLT) time for attack is determined and the target is contrasted against pre-determined mission priorities.

As part of the **attack analysis**, the AFATDS determines which of the several fire support ships[18] is best able to deliver the desired effects on the target and the applicable fire support coordination requirements. If the fire mission

[17] Although not applicable for this operational scenario, a moving target intercept point for attacking mobile targets, and a build-up area check would be accomplished as part of target filtering.

[18] The T+N on each NSFS ship is responsible for reporting to the supported unit when they are on station and ready to receive fire missions, as well as their weapon status and ammunition inventory. The T+N must continuously update the supported unit with the NSFS ship's location, and any change to the weapon status (e.g., local airspace fouled, gun mount casualty, etc.). The T+N must also report ammunition expenditure upon completion of every fire mission and upon request from the supported or higher unit.

violates a FSCM or airspace coordination measure, then the SACC transmits a data coordination message via the AFATDS to the agency that has established the measure.

(For **mission execution**, see T_2)

T_2 The mission is directed to the appropriate ship (firing unit) to execute the fire mission, based upon results of the processing and filtering of the target and the attack analysis. In this scenario, the AFATDS selects NSFS to provide suppression fires to allow attack helos to engage the mechanized force. The AFATDS in the SACC sends a data order to fire (OTF) to the **T**TWCS and **N**FCS (T+N)[19] configuration aboard the firing unit.

T_3 A data message to observer (MTO) is sent from the AFATDS in the SACC to the TLDHS with the NSFS Spot Team providing status of the FR.

T_4 The T+N aboard the firing ship receives the OTF, via the automated digital network system (ADNS), from the SACC. A T+N operator conducts target processing functions to ensure availability of appropriate ordnance and to facilitate local area coordination. The NLT time for ordnance on target is verified. The T+N forwards the target to the Mk 160 gun computer system to conduct a trial solution[20] that is monitored by shipboard personnel. After validation of the trial solution, the mission is scheduled and forwarded as an engagement order to the Mk 160 for execution.

T_5 The T+N operator also sends a message to the NSFS spot team acknowledging receipt of the mission.

T_6–T_8 After the firing ship acknowledges receipt of the mission to the NSFS spot team, data communications flow directly between the NSFS spot team and the firing ship with other interested agencies (SACC, landing force operations center (LFOC), Bn) monitoring. When the firing ship executes the mission, an observer mission update report is sent by T+N to the TLDHS held by the NSFS spot team with a shot report and projected time the ordnance will arrive on target. Additionally, five seconds prior to impact, the T+N aboard the firing ship generates an observer mission update splash report, which is then sent to the TLDHS held by the NSFS spot team. An end of mission (EOM) message with battle damage assessment (BDA), from the NSFS spot team, ends the mission. A mission fired report (MFR) is generated by the firing ship T+N and sent to AFATDS in the SACC. The AFATDS in the SACC updates the firing unit ammunition inventory based on the expenditure reported in the MFR.

4.5.1.4 Insights and Observations

- Replacement of voice communications with data communications for "splash" reports and, to a lesser extent, "shot" reports may require special procedures. Data connectivity will not produce the instantaneous transmission of reports, as is the case with voice communications. Voice splash reports conveyed to observers five seconds prior to ordnance impact are self-confirming as far as receipt and acknowledgement by the observer. The transmission of a data splash report five seconds before impact, however,

[19] T+N is a configuration that allows the NFCS to share the TTWCS consoles. Operator must toggle between NFCS and TTWCS to view each system's display. See Appendix B for individual system descriptions.

[20] A trial solution message is submitted from NFCS to the Mk 160 GCS to assist in mission planning. For a trial solution NFCS provides ownship location data, target location data, environmental data and desired ammunition type (e.g., ERGM) to GCS. GCS then automatically performs technical fire control computations based on these input parameters and returns pertinent trial solution data to NFCS. Trial solution data includes munition trajectories, minimum and maximum times-of-flight, MRSI capability and failure mode hazard areas. The trial solution computations are conducted as background processing within the GCS and do not affect normal GCS processing.

will not guarantee that it is received, much less acknowledged, before impact. A possible solution may be to send the splash time along with an earlier data observer mission update so that the observer's forward entry device could keep track of the predicted impact time and notify the observer several seconds before impact. Other similar anomalies between data and voice processing of fire missions may arise requiring adjustments in techniques and procedures.

- The SACC needs to know that a ship will be able to execute a fire mission the SACC assigns to it. All ships assigned to the general NSFS mission are assumed to be ready to fire unless the ship's commanding officer informs the SACC that he cannot accept a mission for a specific reason (e.g., someone has fouled his ship's local airspace; gun casualty).
- Voice communications provide fire support coordination agencies, ships, supported units, and observers, with the capability to monitor appropriate nets to maintain situational awareness. Data communications, however, require that all necessary agencies are subscribers in the network in order to receive the data being transmitted. The data subscriber network must be configured so that all firing units have all of the unique reference numbers (URNs) of the artillery forward observers, NSFS spot teams, and anyone else who may be involved in fire missions that the firing unit may be assigned.

4.5.2 Naval Surface Fire Support Controlling Unit Role: *U.S. Army, Operations in Urban Terrain, Call for Fire*

4.5.2.1 Special Situation *(see figure 4-4)*

The CJTF attack on ORANGE forces in BLUE Capital City has begun with the objective of regaining control of the city and removing ORANGE forces. Various elements of the ORANGE forces form mobile fire teams of platoon and company-size throughout the city hoping to prolong its occupation of the BLUE capital until world opinion and diplomatic channels force all parties to the peace table rather than fighting a static defense. These mobile fire teams will conduct hit-and-run attacks on allied forces, reinforce or provide fire support to ORANGE positions, and support localized counterattacks.

The Army's response to this tactical threat consists of a three-phased plan: first, detect and track the dispersed mobile ORANGE teams; second, target them; and third, destroy them through a combination of supporting arms and a combined arms quick reaction force.

After ambushing a BLUE mechanized infantry platoon, one such mobile ORANGE team is tracked moving into the U.S. Army's zone of action, then maneuvered into an area by quick reaction forces, and eventually surrounded. The area is isolated from reinforcements. The surrounded mobile ORANGE team refuses to capitulate. Instead, it attempts to break out of its

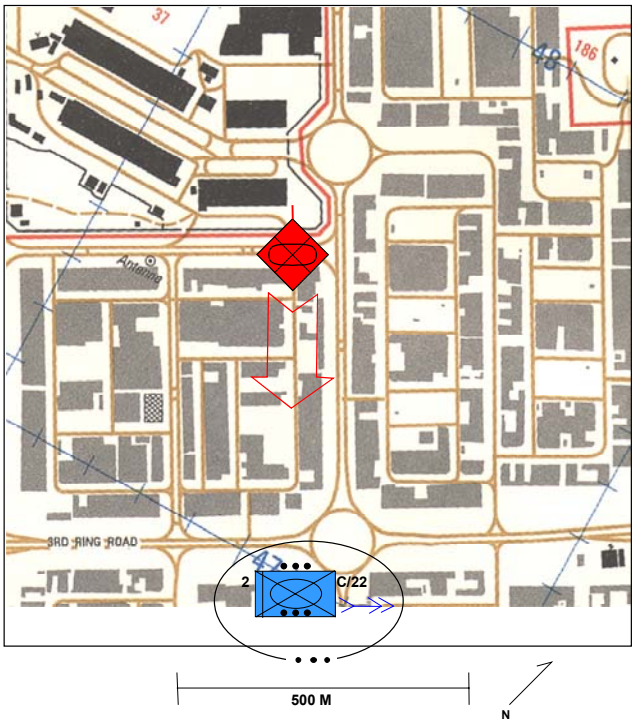


Figure 4-4. U.S. Army, Operations in Urban Terrain

situation by counterattacking in the direction of the closest ORANGE position.

As the mobile ORANGE team counterattacks, it runs into a blocking position established by 2nd Platoon, Charlie Company, 1st Battalion, 22nd Infantry. At time T = zero (T_0) the platoon leader calls for a fire mission on the ORANGE force. The urban terrain the two opposing forces find themselves in is very mixed in shape and layout with high-rise apartment buildings and office skyscrapers, wide and narrow city streets, park areas, and one and two story structures intermingled.

1st Battalion 22nd Infantry has been assigned priority of fire by the brigade commander. All fire requests are routed through the brigade fires and effects coordination cell (FECC) because of concerns regarding collateral damage, coordination with adjacent allied forces, and ammunition levels.

4.5.2.2 Assumptions

- The Army has adopted the fires and effects system concept[21] as a modification to current doctrinal fire support C2 agencies.
- The Army has one corps (three divisions) fully digitized.
- A surface action group composed of a CG and three DDGs is providing naval fires in support of the Army units. The CG is the controlling unit.
- NFCS has a controlling unit capability.

[21] Fires and effects coordination is the continuing process of planning, integrating, and orchestrating full-spectrum fires and effects in support of the combined arms operation to achieve the commander's desired end state. This process includes the management of delivery assets and sensors, and direct coordination with the combined arms commander. Effects-based fires focuses on achieving a desired effect against a target in the battlespace for a specified purpose in the combined arms operation.

4.5.2.3 Sequence of OSD Events

(See operational sequence diagram (OSD), figure 4-8, at the end of this chapter; time sequence indicators below (T_n) correspond to the time sequence numbers on the OSD)

T_0 The platoon forward observer transmits the call for fire, via voice or data, to the company fire support team (FIST) using Force XXI Battle Command Brigade-and-Below System (FBCB2)[22] communications capability. The FIST forwards the call for fire digitally to the brigade using the forward entry device (FED). The platoon forward observer receives feedback on the status of his request (e.g., the request for fire was accepted and is being processed, additional information is required, or fire support cannot be provided with a reason why).

The request for fire goes directly to the brigade FECC[23] with the battalion fire support element (FSE) receiving simultaneous notification so that it can monitor the request.[24] The battalion commander has veto authority over the fire mission. By monitoring the situation and transmission, the battalion FSE ensures compliance with ROE and meets the commander's intent for fires.

T_1–T_6 The AFATDS receives the fire support request and filters, screens, and processes the request. AFATDS prioritizes the request for fire based upon different factors, data, and criteria predefined and uploaded into the system. If AFATDS recommends supporting arms attack the target, it

[22] FBCB2 is a digital battle command and control information system that will provide on-the-move, near real-time battle command and situational awareness, and the ability to generate spot reports, calls for fire, and operation overlays.

[23] The brigade fires and effects coordination cell (FECC) performs all capabilities of a Fire Support Element (FSE) plus it has the ability to integrate available non-lethal capabilities into targeting, to establish a link to the Common Ground Station, manage counterfire, execute information operations, and establish improved joint fires connectivity.

[24] An intervention point has been established at the brigade FECC for all its subordinate units' fires because of concerns about collateral damage, the need to coordinate with adjacent allied forces, and the need to monitor ammunition inventories across the force.

will also recommend an available weapon system to engage the target. In this scenario, NSFS (ERGM unitary warhead) is recommended to attack the target because enemy counterfire radar renders artillery and rocket fire particularly vulnerable. AFATDS generates a fire request and recommends an attack method for the ERGM. The brigade effects coordinator (ECOORD) concurs with AFATDS recommendation.

T_7–T_{11} The recommended use of ERGM requires coordination with the JAOC due to the clearance of fire criteria in effect for coordinating airspace. These criteria are resident in the logic tables of AFATDS. Following input of weapon platform information from the NSFS controlling unit, AFATDS sends an airspace coordination request to the battlefield coordination detachment (BCD) located in the joint air operations center (JAOC). The request is sent through the chain of command (division and corps) via the tactical internet that predominately relies upon EHF radio and SATCOM as communication media. The corps FECC coordinates airspace ashore within its designated boundaries. The JAOC coordinates all other airspace.

With the brigade FECC having selected "Warning Order" in AFATDS for method of control, the fire request is transmitted from the brigade FECC to the controlling unit (CG). The controlling unit forwards the warning order to the firing unit(s) to prepare for the mission. NFCS returns weapons readiness status on all ships through the AFATDS network to the requestor.

The FECC organization includes a NSFS team liaison that advises the ECOORD on the employment of naval fires and communicates the brigade combat team commander's maneuver plan to the controlling unit.

T_{12}–T_{14} JAOC notifies the corps FECC when the airspace coordination is accomplished. An order to fire (OTF) is then transmitted from the brigade FECC via the controlling unit to the firing unit(s) for execution. The controlling unit has the capability to intervene as required.

T_{15}–T_{19} T+N in the CIC on the firing ship(s) receives the OTF with targeting data from the controlling unit. Local airspace coordination is conducted within CIC and potential conflicts identified. (Conflicts that preclude mission execution are provided to the controlling unit.) When authorized by the firing ship's commanding officer or his designated representative, the mission is executed.

T_{20}–T_{21} After the controlling unit receives the OTF, a digital data message to observer is sent to the company FIST. This information is transmitted through the different levels of command. Since it is data being transmitted digitally, the message is monitored simultaneously at all command levels. It does not stop at each level of command to be acknowledged and then forwarded. The FIST communicates fire mission information to and from the platoon forward observer.

Thereafter, the FIST communicates digitally with the controlling unit through the tactical internet systems. The various command levels involved monitor these digital communications simultaneously rather than serially acknowledging them and forwarding them to the next echelon. To conclude the mission the observer sends an end of mission message that includes BDA to the firing ship(s). At end of mission, the firing ship(s) send a mission fired report to the Brigade FECC.

4.5.2.4 Insights and Observations

- Local airspace coordination is the responsibility of each firing ship. All other coordination is performed by the FECC.
- An NSFS liaison team is required at the brigade FECC and Army representation may be required aboard the CG to ensure effective mission execution.

- The U.S. Army Brigade Combat Team must have the capability to communicate directly with a firing ship operating over-the-horizon.
- Digital data communication between the brigade FECC and the controlling unit, which is over the horizon, may have to be relayed. This requirement for a relay could occur if organic over-the-horizon communication equipment below the division command level is not available to provide a direct communications link.
- Digital data communication from the FIST to the firing ship through various command nodes (via tactical internet systems) is nearly simultaneous vice sequential.
- Digital data communication transmissions received at command nodes, acting as servers, will be forwarded via a digital path of least resistance. This path may differ with each transmission and is transparent.
- Digital data systems do not eliminate the need for voice communications.

4.5.3 Naval Surface Strike Single Unit Role: *Strike Mission Against Rebel Forces Attacking a U.S. Embassy*

Although it is recognized that funding for the vertical takeoff unmanned aerial vehicle (VTUAV) and tactical control station (TCS) programs has been withdrawn, this scenario is included to demonstrate the NSS single unit role and illustrate the requirement for an organic targeting capability on surface combatants.

4.5.3.1 Special Situation (see figure 4-5)

Rebel forces, supported by a neighboring enemy government, have successfully maintained a state of unrest in the friendly country of PURPLE for several years. Rebel forces have conducted raids and terrorist attacks and are threatening to overthrow the PURPLE government. Cease-fire and peace negotiations led by a third party have failed to make any progress in reducing the level of rebel activity. In fact, the rebel forces have grown in strength and the level of activity has been increasing.

Recently, the rebel forces have been observed moving from the more remote countryside toward the capital city. The presumed intent of this action is to launch a consolidated attack on the capital city, take control of key facilities, and to attempt to overthrow the PURPLE government. Because of the western support for the PURPLE regime, the rebels have been making strong threatening statements towards the U.S. Embassy. The PURPLE government has made it clear that it will not be able to guarantee the safety of the embassy in the event of a significant rebel assault on the capital.

With evidence mounting that the rebel forces are in fact preparing for a major operation, the United States decides to move the nearest Marine expeditionary unit (MEU) into the area. The MEU is involved in split-ARG training operations. Logistic demands of reembarking troops and equipment from disparate locations and the relatively slow speed of amphibious ships could preclude arrival of the ARG / MEU offshore PURPLE before rebel forces mount what appears to be an imminent attack.

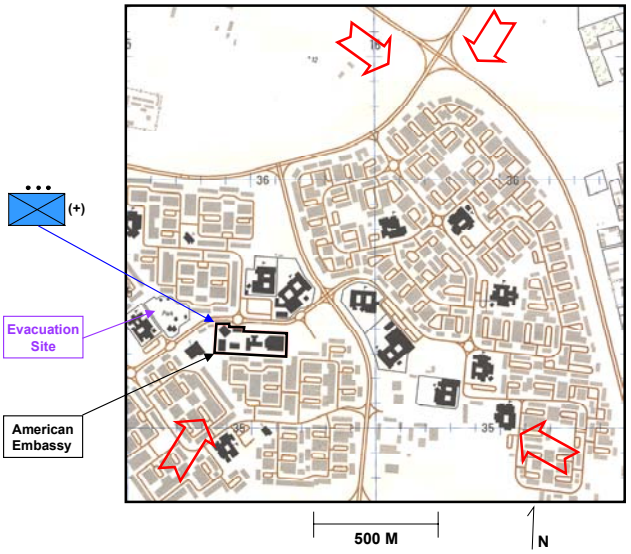


Figure 4-5. Strike Mission

To expedite responsiveness, a reinforced rifle platoon from the MEU is embarked aboard a DDG, which proceeds to the vicinity of the PURPLE capital city at maximum speed. The remainder of the MEU and associated assets follow.

The DDG with a tactical UAV detachment embarked arrives first on scene and 36 hours before the rest of the force. The rifle platoon is shuttled to the embassy to protect American lives and to make preparations for potential evacuation of the embassy should it come under attack by the rebel forces.

The platoon also deploys reinforced squads within the city along avenues of approach to the embassy. The intent is to provide intelligence on rebel activity and movement and to disrupt or delay any rebel attack on the embassy.

Soon after arrival on site, rebel activity and SIGINT indicate that the rebel forces intend to attack the U.S. Embassy, possibly before the remainder of the U.S. force can arrive on scene.

The tactical UAV is employed to provide surveillance of avenues of approach, where preplanned targets have been established. These preplanned targets were selected based on surrounding urban terrain and the desire to limit collateral friendly casualties and damage.

Rules of engagement provide the DDG commanding officer authority to initiate engagement of the enemy when the rebel forces threaten the embassy.

Figure 4-5 provides a map of the operations area in the vicinity of the U.S. Embassy. The primary rebel force concentrations are to the northeast of the city with lesser force concentrations to the southeast.

4.5.3.2 Assumptions

- The ARG and MEU staffs, aboard the amphibious command ship (LHD), conducted considerable mission planning prior to detaching the DDG and associated advanced forces. This pre-planning included (1) resource identification, (2) rules of engagement (ROE), and (3) command relationships. Resource identification dealt with communication plans and equipment, NIMA map/chart products, target acquisition equipment, supporting assets including UAVs or LAMPS. All operation area maps, charts, commander's criteria, and preplanned targets were loaded into the NFCS and TTWCS aboard the DDG prior to arrival on scene.
- The DDG will be 'over the horizon' from the capital city with its operational location approximately 25–50nm from the embassy. This assumption implies that ERGM and TACTOM will be the fire support assets available for the mission and that the communications from the deployed land forces to the firing ship cannot depend upon line of sight only and will require either an airborne relay or UHF SATCOM capability to maintain connectivity.
- The DDG will have full responsibility for all tactical area surface and air coordination. The ability to effectively perform this task is limited by and to ship assets. There is no immediate support available from AWACS or other non-organic assets in the operational area.
- Necessary C4ISRT assets are in place to support situation awareness (SA), intelligence preparation of the battlespace (IPB), planning, cueing and battle damage assessment (BDA)

4.5.3.3 Sequence of OSD Events

(See operational sequence diagram (OSD), figure 4-9, at the end of this chapter; time sequence indicators below (T_n) correspond to the time sequence numbers on the OSD)

Figure 4-9 provides the operational sequence and command and communication relationships for this operation. Because the ARG / MEU is not on scene, the task force (element) commander is the DDG commanding officer. A rifle company XO is deployed with the forces at the embassy. A tactical command net is established between the DDG and the embassy (company XO and rifle platoon). A Marine fire support liaison officer is provided to the ship's CIC.

T_1–T_3 The Marine platoon commander is able to communicate directly with the NFCS aboard the DDG to conduct strikes against preplanned targets. The platoon commander conducts security patrols throughout the urban area surrounding the embassy, identifying likely rebel avenues of approach to the embassy and choke points along those approaches. The platoon commander also collects information that helps define no-fire areas (NFAs) and validate friendly forces locations. Information gathered by the platoon becomes the key planning factor in determining tactical UAV surveillance missions.

T_4–T_6 On the DDG, T+N provides mission planning for targets nominated by the rifle platoon or from other sources. The tactical UAV controlled via TCS on the DDG flies surveillance over routes determined by prior intelligence gathering (reconnaissance patrols, map studies, aerial photos, interviews of local population). The tactical UAV detects rebel troop movement toward the embassy and transmits real-time surveillance data via TCS to the DDG. The DDG commanding officer designates targets to be engaged to prevent or delay a rebel advance on the embassy.

T_7–T_9 The DDG CO is responsible for airspace coordination for the entire operations area in preparation for naval fires missions. Special attention must be paid to any evacuation operations that may be underway. Once airspace coordination has been completed, the CO approves the fire order(s). The T+N passes necessary information to the weapon control systems to launch missiles and/or fire the gun in support of the strike mission(s). The higher headquarters (HHQ) and the embassy are notified when weapons are fired.

T_{10} The tactical UAV collects battle damage assessment (BDA) and continues surveillance of planned areas. The rifle platoon may also be employed to collect BDA. A mission fired report to HHQ and the embassy concludes the mission.

4.5.3.4 Insights and Observations

- Organic targeting capability is required for a surface combatant to perform the NSS single unit role. Note: if no organic targeting capability is available, a significant reachback capability (e.g., naval fires network (NFN))[25] must be provided. The reach back requirement will also necessitate an expanded communications capability onboard the surface combatant.
- An ability to communicate at beyond line-of-sight ranges requires an airborne relay or satellite connectivity.
- Preplanning of targets with the assistance of external agencies will enhance effectiveness of this role.
- The single unit commanding officer needs clear cut lines of authority and ROE to accomplish the mission.
- Liaison officers should be exchanged between the embassy and the ship.

[25] NFN is aggregate of the following systems: GCCS-M, TES-N and JSIPS-N as described in Appendix B.

4.5.4 Naval Surface Strike Multi-Unit Commander and Firing Unit Roles: *JFACC initiates Strike Operations Against Time Critical Targets*

4.5.4.1 Special Situation (see figure 4-6)

Joint task force (JTF) follow-on forces have entered the area of operations and have built up sufficient forces to conduct offensive operations to restore the territorial integrity of the invaded country. During the build up of CJTF forces, the enemy has been able to install a sophisticated and integrated air defense system. The enemy has deployed combined arms forces arrayed in mobile defense with mobile SAM assets linked via shared command and control to coordinate engagements against CJTF air assets. Enemy tactics are to move SAM batteries every two hours unless they have fired on incoming aircraft. When an individual battery fires, it moves as soon as possible. Radar is used in brief periods from multiple sites to confuse true locations and to abate the HARM engagement attempts.

In order to conduct ground offensive operations, local air superiority must be achieved. Multi-service assets will be used to detect targets. JFACC will provide available target information for engagement. A SAG consisting of a CG (multi-unit commander) and two DDGs (firing units) is directed to respond to time critical targets detected by JTF sensors.

The JFACC ashore is coordination authority for all fires and aircraft in the zone of action. The multi-unit commander coordinates local airspace when conducting naval fires. A dedicated EHF SATCOM data channel has been established between the joint air operation center (JAOC) and the multi-unit commander.

A JSTARS aircraft has been monitoring an area of interest for likely transporter-erector-launcher (TEL) positions approximately 25 miles inland in the vicinity of hills 210 and 200. Route 15 runs east to west between the hills and through a forested area about 15 miles long. A mobile SAM system, detected by onboard sensors of the JSTARS aircraft, has been located at the eastern edge of the forested area. The SAM is providing air defense coverage for the TEL and would impose a high risk to tactical aircraft attacking the TEL. The SAM would also be effective against missiles such as TACTOM.

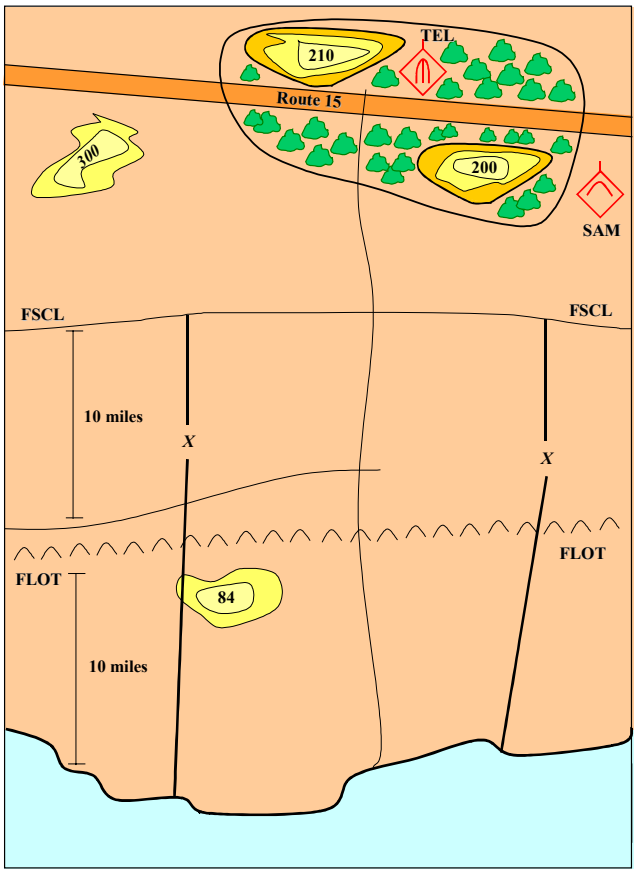


Figure 4-6 JFACC Initiates Strike Operations

4.5.4.2 Assumptions

- JAOC has the systems and manning necessary to coordinate fires in the battlespace in near real-time.
- A naval coordination detachment (NCD) has been established and collocated in the JAOC as part of the joint fires cell.
- The multi-unit commander (CG) has an NFN-like capability.

- Sensors can provide timely and accurate target locations needed to effectively employ precision munitions.
- TACTOMs have been allocated to support this mission.
- The command and control capability exists to be able to distribute and assign targets.

4.5.4.3 Sequence of Events

(See operational sequence diagram (OSD), figure 4-10, at the end of this chapter; time sequence indicators below (T_n) correspond to the time sequence numbers on the OSD)

Up to T_0 Based upon the commander's guidance, the JAOC tasks the JSTARS aircraft and its target acquisition sensors. The sensors must be able to identify and classify the number of contacts in relation to time. These sensors are required to give locations of the targets and provide the mapping frame of reference, to give the target location error associated with the contact, and to indicate if there is any movement detected within the target area.

The JSTARS mission is to detect and identify potential targets or target sets and downlink this information to the Army common ground station (CGS) collocated with the JAOC ashore. This information is transmitted via a surveillance control data link (SCDL).[26]

T_0 The JSTARS detects a suspected TEL and SAM.

T_1–T_2 The JAOC initiates the targeting process upon receipt of the target detections from JSTARS, focusing initially on validating the target(s). The JAOC joint fires cell confirms target identification and determines the specific target locations based on the best available target information. Key items of information used in mission planning are the commander's guidance, the rules of engagement, fire support coordination measures, and other battlefield geometry along with the air control order and air tasking order. JAOC designates the TEL and SAM as time critical targets and determines that the best engagement option is to attack them with naval fires.

T_3–T_4 The JAOC has a joint fires cell that includes an NCD to assist in planning and executing naval fires. The NCD would be a small liaison element with enough personnel to maintain 24-hour operations. In this scenario, the NCD recommends to the JAOC that this mission be assigned to the NSS multi-unit commander. The JAOC joint fires cell passes the validated target information to the NSS multi-unit commander with instructions to destroy the TEL.

T_5–T_8 Upon receipt of mission tasking, the NSS multi-unit commander augments information received from the JAOC with information available from NFN to refine targeting data. The NSS multi-unit commander plans for a coordinated strike to suppress the SAM and destroy the TEL. The NSS multi-unit commander then conducts weapon-target pairing and decides to suppress the SAM with ERGM while attacking the TEL by providing an aimpoint update to a loitering TACTOM under control of one of the DDGs. The NSS multi-unit commander coordinates local airspace for itself and the firing units, and issues tasking orders to the two DDGs. DDG(1) is instructed to prepare a new aimpoint (the TEL) for its loitering TACTOM to be executed upon command of the NSS multi-unit commander. DDG(2) is instructed to suppress the SAM with ERGM upon command of the NSS multi-unit commander.

T_9–T_{13} Both firing units (DDGs) receive their tasking orders from the multi-ship unit and prepare their missions, reporting computed time on target back to the NSS multi-unit commander. The NSS multi-unit commander plans for the coordinated suppression and destruction

[26] SCDL is a time division multiple access data link incorporating flexible frequency management. The system employs wideband frequency hopping, coding, and data diversity to achieve robustness against hostile jamming.

missions and provides orders to fire to the DDGs with precise time on target requirements and, for the suppression mission, a duration of fire. Once final airspace coordination is effected, the NSS multi-unit commander transmits the command to execute the coordinated attack.

T_{14}–T_{15} Via NFN, the NSS multi-unit commander obtains BDA confirming destruction of the TEL. A mission complete is transmitted to the firing units, the JAOC/JFACC, and the NCD.

4.5.4.4 Insights / Observations

- Sensors must be able to provide significant information about the enemy TEL and its protective SAM. This information would include identification and classification of the targets with respect to time, target location along with the accuracy of the location (i.e., target location error), and indication of expected target dwell time (e.g., the time the TEL is expected to remain in its current location).
- The NSS multi-unit commander must have an NFN-like capability in order to conduct this mission.
- The process of performing BDA needs to be planned in advance to determine if reattack is required.
- Airspace coordination is a shared responsibility. Target area coordination was the responsibility of the JAOC. The launch and over-water coordination was the responsibility of the NSS multi-unit commander.
- An agency (i.e., cell, detachment, element) is required to plan and coordinate joint fires for the JTF. This agency should be composed of members of the JFC's staff, representatives of the component commanders, and other experts as needed. This agency would provide the capability to accomplish joint fires planning and coordination functions. A joint fires cell concept has been experimented with as part of several Fleet Battle Experiments in several different shipboard and shore based configurations. Air Force experimentation has examined different internal organizational architectures for a fire cell within the JAOC. Experimentation involving Marine Corps and Army fires element organization has also taken place. The common thread in each of these efforts is functions and not systems.

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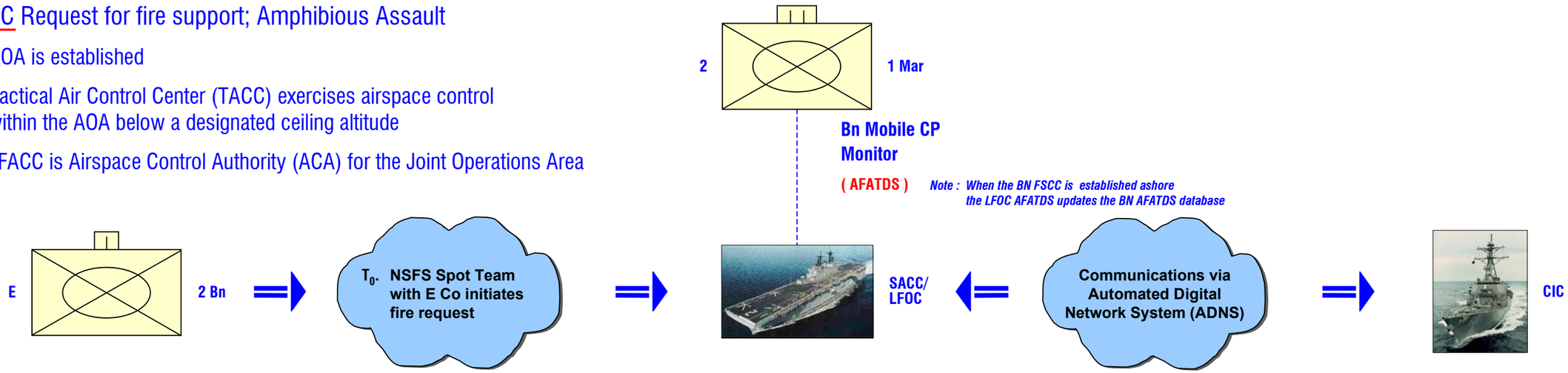
Naval Surface Fire Support Supporting Unit Role Operational Sequence Diagram

USMC Request for fire support; Amphibious Assault

- AOA is established
- Tactical Air Control Center (TACC) exercises airspace control within the AOA below a designated ceiling altitude
- JFACC is Airspace Control Authority (ACA) for the Joint Operations Area



Tactical Scenario:

The mission of the ATF is to prevent enemy occupation of the vital port and industrial complex in Country Orange to facilitate the reception of follow on forces in theater.

The lead battalion of an enemy motorized rifle regiment is located 16 km east of Red Beach. Enemy forces are consolidating their positions and displacing logistics forward. Indications are that the enemy will move to occupy the port and industrial complex (10 km west of Red Beach) within the next several days.

The mission of BLT 2/1 is to attack across Red Beach 1 at 0600, D-Day, to seize Division Objective 1 and establish a blocking position to prevent the movement of enemy forces, along Route 15, into the port and industrial complex.

The BLT 2/1 commander's intent is to conduct a surface assault across Red Beach 1 with two companies abreast, avoid decisive engagement on or near the beach, and move swiftly inland to seize the high ground, in zone, which dominates Route 15.

At 0530, thirty minutes before H-Hour, a reconnaissance team on Hill 300 observes an estimated platoon sized enemy mechanized unit (with two ZSU-23 / 2 twin towed AA systems) in the vicinity of Hill 84 on the left flank of BLT 2 / 1's axis of advance. Informed of this development, the BLT 2 / 1 commander decides not to alter his scheme of maneuver, but to try to neutralize the enemy unit by fire and bypass. If that fails, he would have his left flank company (E Co) block the enemy advance while his right flank company (F Co), and reserve company (G Co) move swiftly to seize the objective.

The BLT 2 / 1 commander notifies the E Co commander of the threat and reminds him that attack helicopters are on station and available to attack the enemy mechanized forces, but that the ZSU-23's need to be suppressed before the helos go in. The E Co commander immediately briefs his platoon commanders, his forward air controller, and his NSFS Spot Team of the situation. He directs the NSFS Spot Team, equipped with TLDHS, to strive for first round accuracy in the suppression mission both to prevent effective employment of the weapons and to hinder their displacement to new firing positions before the attack helicopters can complete their attack on the enemy mechanized forces.

Fifteen minutes after crossing Red Beach, the NSFS Spot Team observes the enemy mechanized platoon advancing on E Co's left flank, and detects the two ZSU-23's in firing positions. The NSFS Spot Team sends a call for fire to the SACC at "Time Zero" (T_0).

Data/Voice

Data:

- *DACT/TLDHS (NSFS Spot Team to SACC)*

Most likely DACT Tactical Communications Interfaces:

- *HF: AN/PRC - 104/138*
- *VHF/FM: SINCGARS*
- *SATCOM UHF: AN/PSC - 5*

Voice:

- *VHF/FM SINCGARS*
- *HF AN/PRC-104*

SACC Automated Fire Support and Mission Planning Systems (Core System = AFATDS)

T_0. Receive fire request; pass data to SACC AFATDS

T_1. Process fire request

- Conduct target processing
- Conduct target filtering
- Conduct attack analysis:
  - Perform weapon - target pairing
  - Recommend best weapon system available to engage target (CAS/NSFS)
  - Check compliance with FSCMs (see note below)

T_2. Executes the fire mission (selects NSFS (ERGM) and a specific fire support ship); directs selected ship to execute the mission by sending it an Order To Fire (OTF) (To T_4)

T_3. Sends digital message to observer (MTO) to NSFS Spot Team with E Co, BLT 2/1.

Note: Airspace coordination and deconfliction conducted between TACC and SACC; NFC coordinates with ACA as required

Via local area network

Landing Force Operations Center (LFOC)

Monitor

AFATDS Update Bn AFATDS database

To NSFS Spot Team

Message to NSFS Spot Team

During mission execution NSFS Spot Team Communicates with firing unit

Firing ship(s) CIC T+N (TTWCS-NFCS)

T_4.
- T+N within CIC aboard Firing Unit (DDG/CG) receives Order to Fire from SACC AFATDS
- T+N checks that batteries released is "go"; T+N and weapon system processes ballistic trajectory, and alerts the T&N operator for possible conflicts

T_5. T+N issues an engagement order to the weapon system. T+N sends a data message to NSFS Spot Team acknowledging mission; or transmits a CANTCO (can't comply) as a data message to the SACC

T_6. Thereafter, the observer communicates via data link with the shooter, others (SACC, LFOC, BN) monitor;

T_7. End of Mission message from observer to firing ship concludes mission (voice communications as backup)

T_8. After rounds complete, Mission Fired Report sent to SACC

MFR to SACC

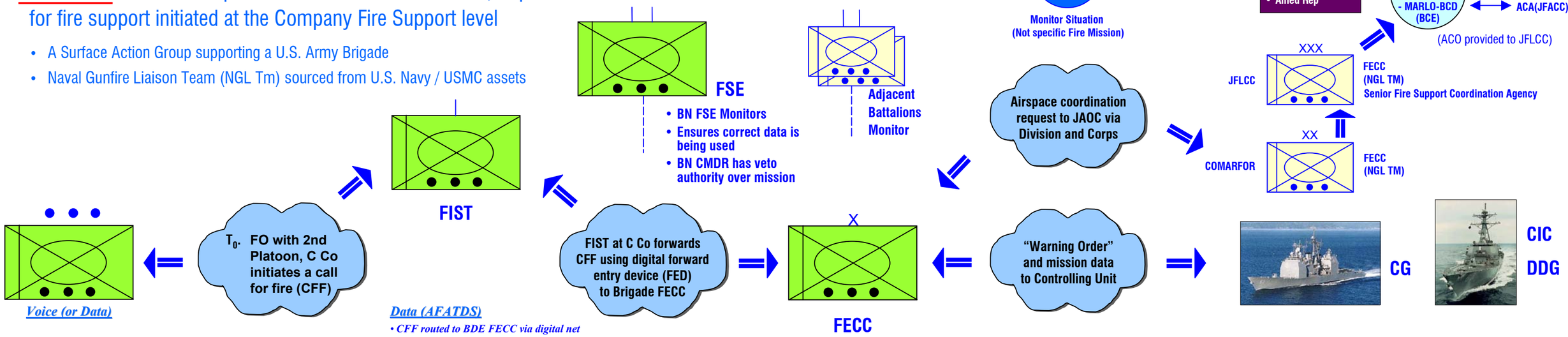
Figure 4-7

22 October 2002

Naval Surface Fire Support Controlling Unit Role Operational Sequence Diagram

U.S. ARMY Sustained operations ashore in urban terrain; request for fire support initiated at the Company Fire Support level

- A Surface Action Group supporting a U.S. Army Brigade
- Naval Gunfire Liaison Team (NGL Tm) sourced from U.S. Navy / USMC assets



TACTICAL SCENARIO U.S. ARMY:

The CJTF attack on ORANGE forces in BLUE Capital City has begun with the objective of regaining control of the capital city and removing ORANGE forces. Rather than fighting a static defense, and hoping to prolong its occupation of the BLUE Capital City until world opinion and diplomatic channels force all parties to the peace table, various elements of the ORANGE forces in BLUE Capital City form mobile fire teams of platoon and company-size throughout the city. These mobile fire teams will conduct hit and run attacks on allied forces, reinforce or provide fire support to ORANGE positions, and support localized counterattacks.

The Army's response to this tactical threat consists of a three-phased plan: first, detect and track the dispersed mobile ORANGE teams, then target them, and finally destroy them through combination of supporting arms and a combined arms quick reaction force.

After ambushing a BLUE mechanized infantry platoon, one such mobile ORANGE team is tracked moving into the U.S. Army's zone of action, then canalized into an area by quick reaction forces, and eventually surrounded. The area is isolated from reinforcements. The surrounded mobile ORANGE team refuses to capitulate. Instead, it attempts to break out of its situation by counterattacking in the direction of the closest ORANGE position.

As the mobile ORANGE team counterattacks it runs into a blocking position established by 2nd Platoon, Charlie Company, 1st Battalion, 22nd Infantry. At time = zero (T_0) the Platoon Leader calls for a fire mission on the ORANGE force. The urban terrain the two opposing forces find themselves in is very mixed in shape and layout with high-rise apartment buildings and office skyscrapers, wide and narrow city streets, park areas, and one and two story stores all intermingled.

1st Battalion 22nd Infantry has been assigned Priority of fire by the Brigade Cdr.

Because of concerns regarding collateral damage, coordination with adjacent allied forces, and ammunition levels, all fire requests go through the Brigade FECC.

AFATDS (Brigade FECC):

T1. Filters, screens, & processes requests for fire support

T2. Prioritizes target engagement:
- CDR's targeting guidance & attack criteria (includes target - weapons pairing)
- Target Characteristics
- Target Value Analysis
- Weapon Systems Availability
- Weapon Systems Capability
- JMEM data
- FSCM / Unit Zones of Action complied with

T3. Recommends target engagement (or not). If yes, recommends an optimum weapon system available to engage target:

FA / AIR / NSFS (ERGM) / TACTOM / ROCKET / MORTAR

Enemy counterfire radar renders artillery and rocket systems particularly vulnerable

T4. Generates a Fire Request

T5. Recommends an attack method for selected system(In this case the MK 34 GWS)

(To T6)

Notes:
- An intervention point has been established at the Brigade ECT for all missions
- Readiness status of ships in Expeditionary Strike Force directly fed by NFCS into AFATDS network

Brigade FECC:

T6. Brigade ECOORD concurs with AFATDS recommendation; sends message to observer (MTO), mission accepted being processed

T7. NFSF (ERGM) recommendation requires coordination with the JAOC (BCD) due to the clearance of fire criteria in effect for coordinating airspace

T8. AFATDS automatically sends airspace coordination request (Request for Coordination) to JAOC (BCD) via Division and Corps command levels using tactical internet
- Corps FECC coordinates airspace ashore below airspace coordination altitude
- JAOC coordinates all other airspace ashore and afloat

T9. NSFS Team at Bde coordinates with controlling unit (CG) to know status of each ship in the fire support group and to keep controlling unit informed of Army situation. (Both an automated and manual process)

T10. Brigade FECC selects " Warning Order" for Method of Control and sends mission data to the Controlling Unit.

(To T11)

T12. JAOC sends message back to Corps that airspace has been coordinated

T13. After coordination of airspace has been completed, an Order to Fire (OTF) is transmitted automatically from Brigade FECC to the Controlling Unit

(To T14)

FIST communicates fire mission information to and from platoon leader

Data/Voice Feedback to Sender:
(1) Concurred with by Brigade FECC; being processed or forwarded
(2) Additional information required
(3) Cannot fire - reason stated

Controlling Unit CIC TTWCS/NFCS (T+N)

T9a. Controlling Unit informs NSFS Team at Bde on status of all firing units

T11. Controlling Unit forwards "Warning Order" mission data to firing unit(s) allowing the ship(s) to prepare for the mission

(To T12)

T14. Controlling Unit, via AFATDS / T+N interface receives OTF, forwards OTF to firing ship(s); retains capacity to intervene as required

(To T15)

T20. The Controlling Unit sends a digital message to observer to the company FIST, which communicates it to the platoon

T21. Thereafter the FIST communicates digitally with the Controlling Unit through the command nodes (via tactical internet systems); end of mission (BDA) message from observer to Controlling Unit concludes mission; after EOM, T+N transmits MFR message to Brigade FECC

Digital (data) Feedback to Sender:
(1) Receipt acknowledged
- *Accepted, being processed*
- *Additional information required*
- *Cannot fire - deny - reason stated*

(2) Message to FIST - "Shot", "TOT"

Firing Unit(s) CIC TTWCS/NFCS (T+N)

T15. T+N aboard firing unit(s) receives OTF with targeting data from Controlling Unit

T16. CIC conducts local airspace coordination, identifying potential conflicts - notifies Controlling Unit of any conflict that precludes mission execution

T17. T+N notifies Controlling Unit if fire mission is executable

T18. T+N passes necessary information to the gun weapon control system to execute mission

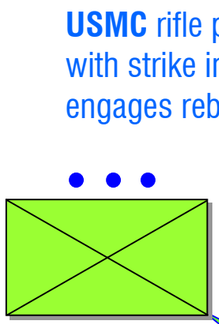
T19. T+N issues a fire order

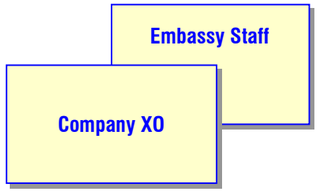
(To T20)

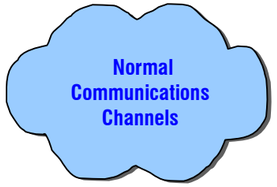
Figure 4-8

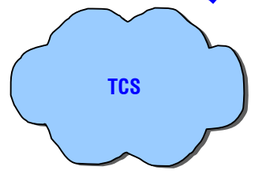
Naval Surface Strike Single Unit Role Operational Sequence Diagram

USMC rifle platoon and ship-based tactical UAV provide a single surface combatant with strike information in the defense of a U.S. embassy. Surface combatant engages rebel forces advancing on the embassy.









CIC

DDG

LHD
(Arrives 36 hrs behind DDG)

Tactical Scenario:

Rebel forces, supported by neighboring enemy government, have maintained a state of unrest including terrorist type attacks within friendly country of PURPLE for several years. Recent third party led cease fire negotiations have failed. Rebel forces have grown in strength and activity. They have been observed moving from the countryside toward the capital city with the presumed intent of overthrowing the PURPLE government. Because of western support of the ruling regime, rebel forces are making strong threatening statements towards the US Embassy. PURPLE government is unable to guarantee safety of embassy.

A reinforced rifle platoon (with its company's XO) from the nearest MEU is put aboard DDG which proceeds to the capital city at maximum speed. The remainder of the MEU and associated assets follow. The DDG arrives first on scene 36 hours before the remainder of the force. At time = zero (T_0) the rifle platoon is shuttled to the embassy to protect American citizens and prepare for their evacuation. The DDG's tactical UAV is deployed along avenues of approach within the city to observe any rebel movements and to provide organic targeting data.

Rebel activity and SIGINT indicate that the rebel intention is to attack the US Embassy. Judgement is that the attack will occur before the remainder of the US force can arrive on scene.

The rifle platoon identifies planned targets along avenues of approach to the city and to the embassy. The tactical UAV monitors avenues of approach to the embassy. The tactical UAV detects targets for naval strike and sends data via the Tactical Control System (TCS) to the DDG when the rebel force moves toward the embassy.

Rifle Platoon:

T1. By map studies and security patrols identifies target locations (e.g. avenues of approach, choke points) for tactical UAV deployment and potential strike opportunities; provides targeting data that is entered into T+N

T2. Identifies friendly unit locations and No Fire Areas (NFA)

T3. Provides Situation Reports as required.

(To T4)

T+N (TTWCS and NFCS):

T4. T+N provides mission planning for pre-planned targets.

T5. Tactical UAV controlled by DDG via TCS detects rebel troop movement toward embassy and sends surveillance data via TCS to the ship.

T6. Ship CO designates targets to be engaged to prevent or delay enemy troop movement toward the U.S. embassy.

T7. CIC performs airspace coordination for entire operation area to include naval strike missions and evacuation execution. Ship CO approves fire order.

T8. T+N passes necessary information to weapon control system aboard the ship to launch missiles and/or fire guns to execute strike mission.

T9. Data / voice message to higher headquarters and embassy on status of strike mission's execution.

T10. Ship employs tactical UAV to collect BDA (if troops ashore are not in position to provide BDA) and to continue surveillance of planned areas. Ship sends Mission Fired Report to embassy.

Figure 4-9

Naval Surface Strike Multi-Unit Commander and Firing Unit Roles Operational Sequence Diagram

JFACC initiates strike operations against Time Critical Targets (TCTs): a Transporter-Erector-Launcher (TEL) and a co-located mobile surface-to-air missile (SAM) battery. An aegis surface action group is available to respond to taskings from Joint Air Operations Center (JAOC – USAF responsibility) ashore.

JSTARS

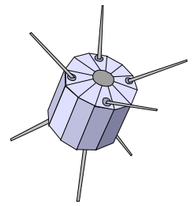
Theater Battle Management Core System (TBMCS)

JFMCC

JFACC

JAOC & CGS

EHF SATCOM Channel



Tomahawk Strike Network (TSN)

Tomahawk Strike Network (TSN)

CG

Automated Digital Network System (ADNS)

DDG (1)

DDG (2)

[Note: A Naval Coordination Detachment (NCD) is located in the JAOC]

Tactical Scenario:

A JSTARS aircraft has been monitoring an Area of Interest (AOI) with likely Transporter Erector Launcher (TEL) positions approximately 25 miles inland within a forested area about 15 miles long. At time = zero (T_0) an mobile SAM battery, and TEL detected by on-board sensors of the JSTARS aircraft, have been located in the forested area. Target locations are sent to a U.S. Army common ground station (CGS) co-located with the JAOC via a Target Nomination message.

The TEL and SAM battery are located beyond the FSCL at a range of 50 nm from a surface action group. Target locations are sent to shooters, via a Target Nomination message, by in-theater systems co-located with the JAOC (CGS).

Data / Voice

JSTARS / via CGS sends target nomination message to JAOC

JAOC and CGS Processing :

T1. Joint fires cell nominates TEL and SAM battery as time critical targets (TCT) to JAOC.

T2. JAOC declares TEL and SAM battery as TCTs. JAOC fires cell reviews units available, systems capabilities and target requirements.

T3. Naval Coordination Detachment (NDC) recommends mission be assigned to Navy.

T4. JAOC (NCD) transmits tasking order to Multi-Unit Commander (info JFMCC) to conduct strike against the TEL and SAM battery.

(To T5)

Comms From JAOC (NCD)

- *EHF SAT Comm*

Pre Planning:

1. *Weapons allocated and apportioned*
2. *CIC is set in Condition II Strike*
3. *Organize for Combat:*
   - *Checklists completed*
   - *Magazines prepared*
   - *Consoles allocated*
   - *Systems Op checked*

Multi-Ship Unit Commander Processing:

T5. Multi-Ship Unit Commander receives tasking order. Naval Fires Network (NFN) receives and processes imagery and ELINT; provides the planning data for preparing strike against the TEL and the SAM battery.

T6. Plans for coordinated strike: suppress SAM battery with ERGM and attack TEL by providing a new aimpoint to a loitering TACTOM

T7. Conducts local area airspace coordination. (JFACC has coordinated airspace in target area)

T8. Naval fires coordinator via T+N directs one firing unit to engage SAM battery and another to provide new aimpoint to its loitering TACTOM

(To T9)

T14. BDA confirms TEL destroyed; notifies JFACC and firing units.

T15. Multi-Ship Unit Commander notifies JFACC and firing unit mission complete.

Firing Units Processing :

T9. DDG (1) receives tasking order via T+N to prepare new aimpoint for its loitering TACTOM.

T10. DDG (2) receives tasking order via T+N to provide suppressing fires (ERGM) on SAM battery.

T11. DDG (1) TTWCS sends aimpoint update to in flight TACTOM when directed by Multi-Ship Unit.

T12. DDG (2) NFCS sends fire order to guns for SAM battery suppression as directed by Multi-Ship Unit.

T13. Batteries are released, weapons are launched, and mission completed.

(To T14)

Figure 4-10

5.0 COMMUNICATIONS

This chapter provides an overview of the communications networks and external interfaces necessary to control surface combatant land attack missions. It also highlights key issues relevant to the design of an effective land attack communications system.

5.1 INTRODUCTION

Surface combatants must be able to communicate with supported maneuver forces, the battle force, Tomahawk mission planning facilities and systems, and joint force and theater command centers. Communications for land attack will be satisfied by a blend of voice and data communications systems. Land attack systems are highly dependent on effective communications among command, control, communications, computer, intelligence, surveillance, reconnaissance, and targeting (C4ISRT) assets; supported units ashore; and firing units afloat.

Communications with airborne platforms, ground forces ashore, and among ships involves systems ranging from short-range, line-of-sight (LOS) relay communications, to over-the-horizon (OTH) communications, including satellite systems.[1] Advances in sensors, precision targeting systems, command and control systems, weapons, and digital information exchange have led to increased land attack operational capabilities. Once these systems are fully integrated, surface combatants will have the capability to simultaneously conduct naval surface strike (NSS) and naval surface fire support (NSFS) missions from the same platform at a faster pace, with improved situational awareness, and with increased lethality.

Communications during NSFS operations include high frequency (HF), very high frequency (VHF), ultra high frequency (UHF), and extremely high frequency (EHF) radio systems. The surface combatant's radio system and networking infrastructure (ISNS/ADNS) provide both voice and data connectivity to amphibious ships and to maneuver force fire support coordination elements ashore. This also constitutes a supporting reachback infrastructure providing imagery, intelligence, other supporting data, and command and control connectivity.

For long-range NSS missions, fleet satellite communications in the UHF, super high frequency (SHF), and EHF bands provide required connectivity between Tomahawk command and control agencies and weapons platforms. Fleet operations centers and naval force units currently exchange data using a number of information exchange systems to develop an OTH tactical picture for planning Tomahawk overwater routes.

Figures 5-1 through 5-5, presented on the following pages, illustrate notional communications structures that support land attack. See appendices B and C for system descriptions.

[1] Details of these and other related communications systems are provided in Appendix B.

Land Attack Supporting Communications Systems

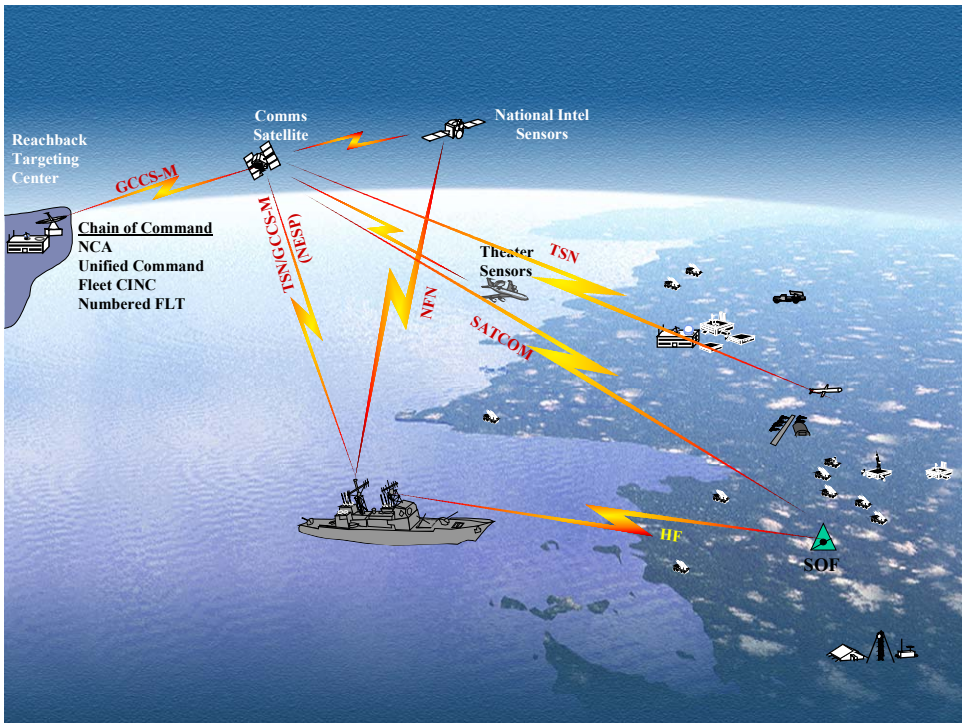


Figure 5-1. NSS Single Unit Role

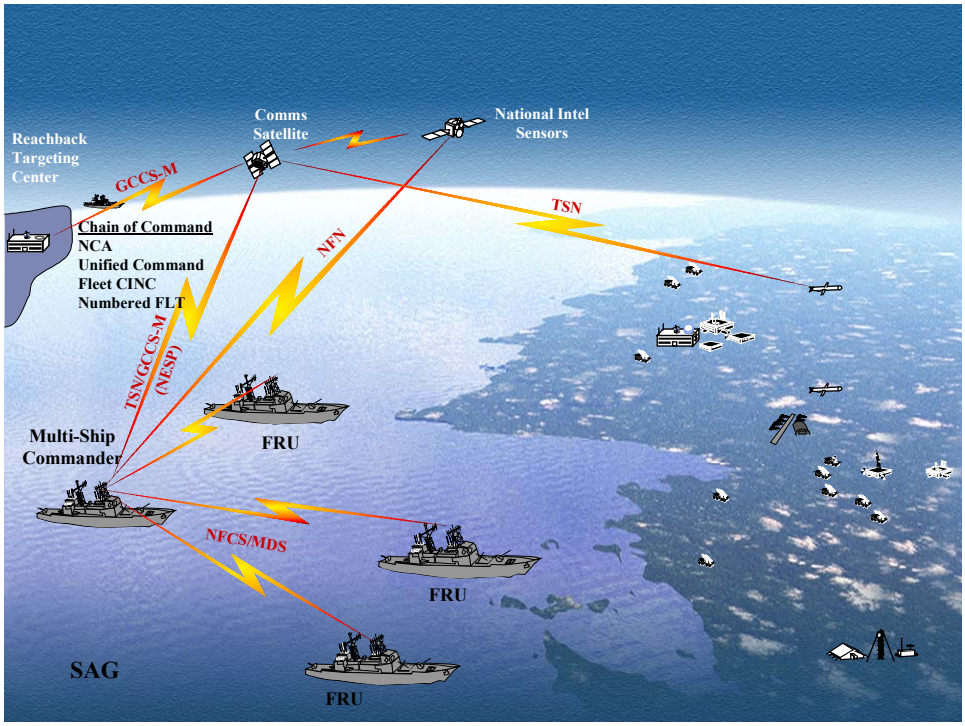


Figure 5-2. NSS Multi-Unit Commander Role

Land Attack Supporting Communications Systems

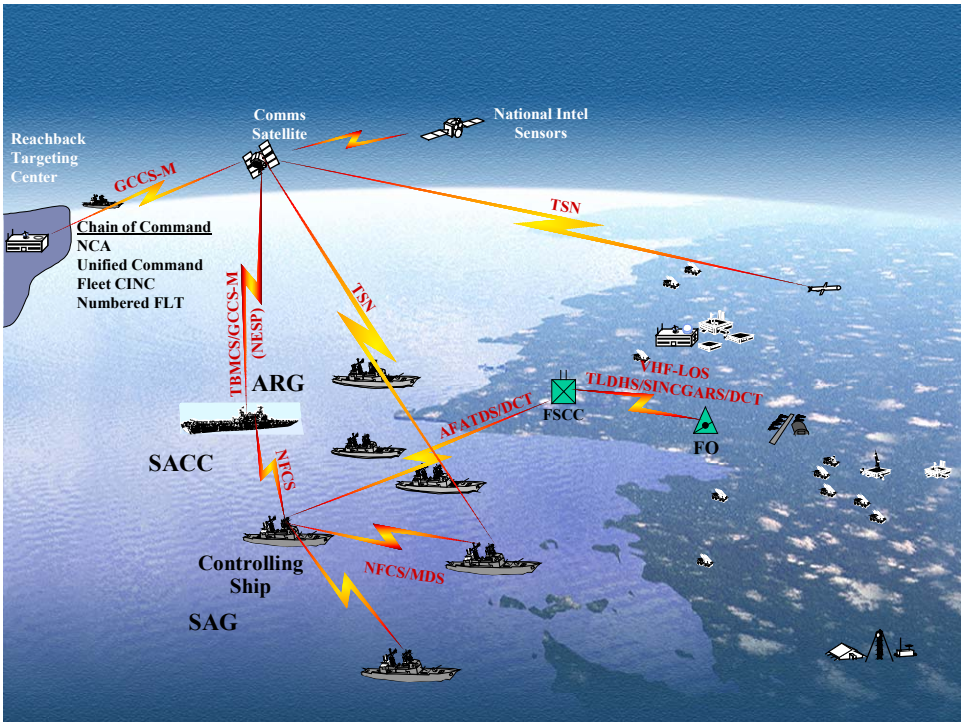


Figure 5-3. NSFS Controlling Unit Role

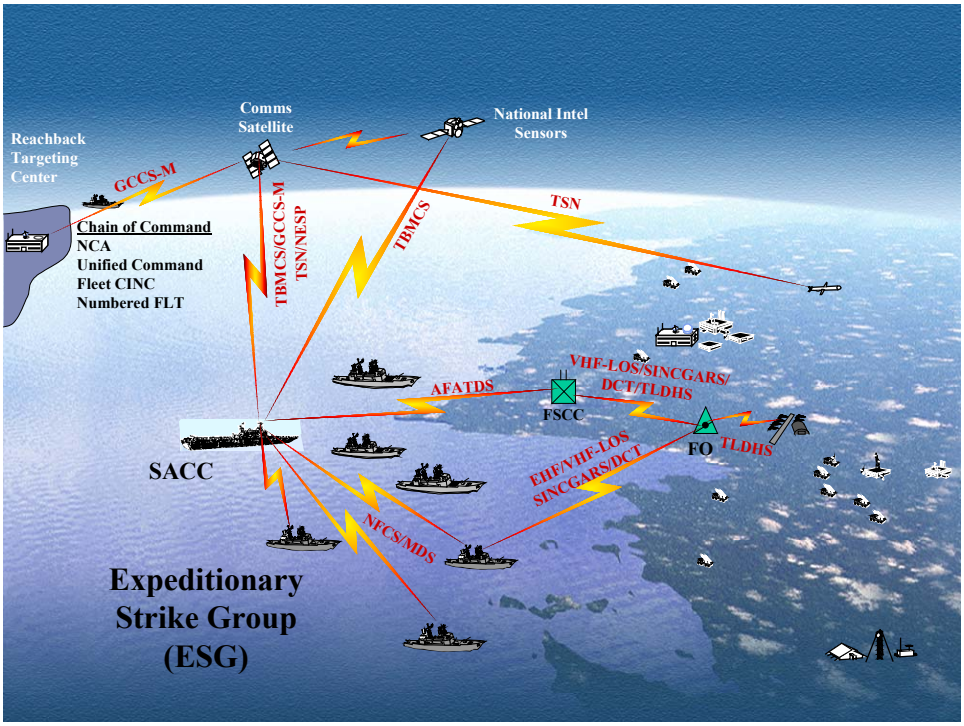


Figure 5-4. NSFS Supporting Unit Role

Land Attack Supporting Communications Systems

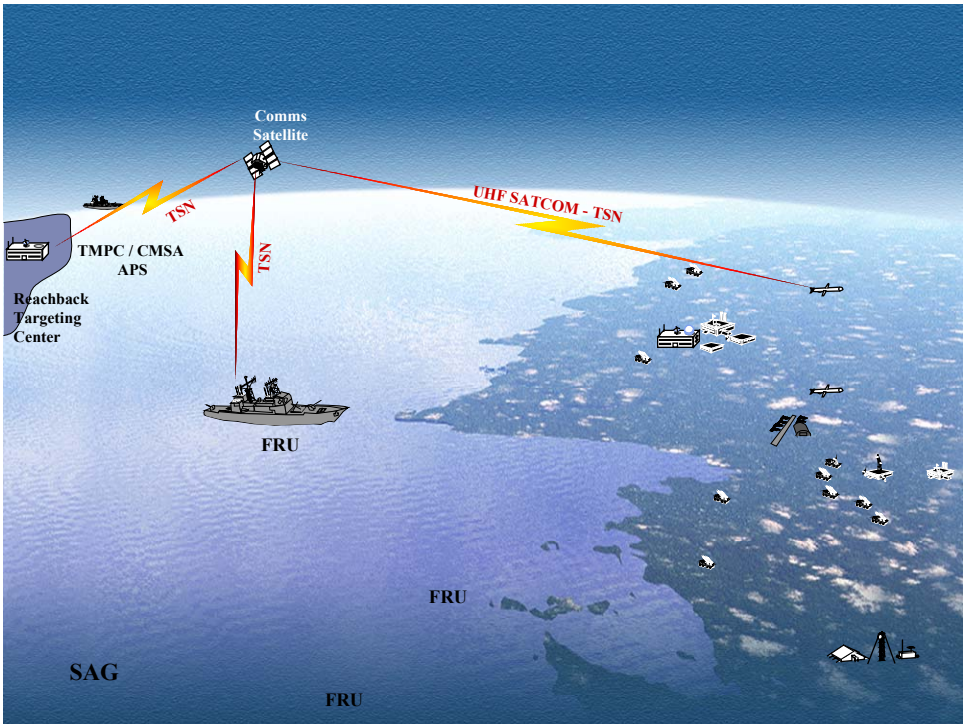


Figure 5-5. NSFS Firing Unit Role

5.2 LAND ATTACK MISSION PLANNING SYSTEMS EXTERNAL INTERFACES

The land attack mission planning systems, Tactical Tomahawk weapons control system (TTWCS) and naval fires control system (NFCS) (T+N), onboard the surface combatant will be interoperable with the C4I systems as shown in Figure 5-6. These external interfaces will provide the land attack operational orders, common operational picture, and fire missions. The internal interfaces for TTWCS and NFCS are shown in light gray for completeness and are discussed further in the *Surface Combatant Land Attack System Requirements Document.*[2]

TTWCS will support the employment of all Tomahawk missiles, and provide on-board mission planning for the Tactical Tomahawk missile. The Tomahawk command and control system connects the external Tomahawk communications system (TCOMMS) to both TTWCS and the new personnel computer-based mission distribution system (MDS). MDS interfaces with the ashore cruise missile support activities (CMSA), the carrier-based afloat planning systems (APS), the Tomahawk command and control nodes, and the in-flight Tomahawk missiles. TCOMMS provides communications links via the STU-III and ADNS, as well as the EHF and UHF satellite communication (SATCOM) nets. All Tomahawk

[2] The *Surface Combatant Land Attack System Requirements Document: Increment 1 – 2003(U),* (DRAFT) dated 28 March 2001 was produced by the Systems Working Integrated Product Team within the Land Attack Capstone Organization.

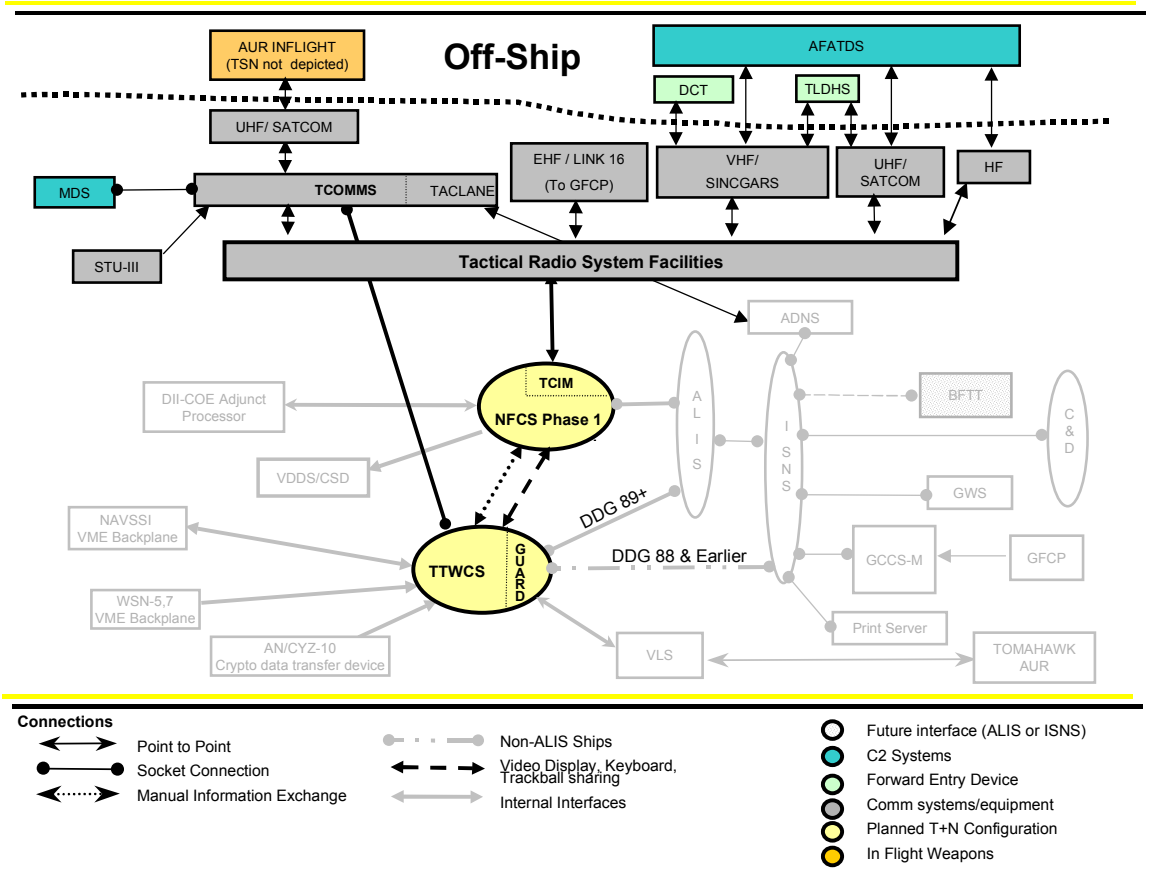


Figure 5-6. T+N External Communication Interfaces

systems are designed to send and process top secret strike missions, and thus have been historically isolated from the tactical fire support world and the rest of the Aegis combat system. TTWCS (using a security guard) accesses global command and control system (GCCS-M) information via the Aegis LAN interconnect system (ALIS).

NFCS is the surface combatant's naval surface fires support (NSFS) mission planning and coordination system for the ballistic and extended-range gun launched weapons. NFCS connects via several tactical radio systems (VHF, UHF, or HF) to ship- and shore-based advanced field artillery tactical data system (AFATDS), and forward observers using target location designation and handoff system (TLDHS). NFCS uses ALIS to talk to the gun weapon system, access GCCS-M data, and receive external IP-based data via ADNS.

5.3 COMMUNICATIONS ISSUES

New systems and concepts rely heavily on uninterrupted communications links. Joint and coalition operations require a certain level of commonality and interoperability in the design and operations of communications systems. The following section addresses specific topics of relevance to the challenge of land attack warfare.

5.3.1 Over-the-Horizon (OTH) Communication with Maneuver Forces

A significant deficiency in the overall C4ISRT framework for surface combatants conducting land attack warfare (LAW) missions is the limited capability to conduct reliable OTH ship-to-shore point-to-point (ship to forward observer) communications. The introduction of longer range munitions such as ERGM and Tactical Tomahawk

will necessitate reliable extended range OTH communications with maneuver forces, both Marine Corps and Army.

Communications equipment available to support LAW includes the following:

- The very high frequency (VHF) single channel ground and airborne radio system (SINCGARS) is widely populated and extensively employed by all maneuver forces. SINCGARS provides the voice and a minimal data backbone for the radio net that is used by fire support systems. These radios are limited to line-of-sight (LOS) ranges with a relay capability provided by connecting two radios back-to-back. Because of this configuration, tactical data messages may be delayed several minutes at each relay point. SINCGARS are installed in all amphibious ships and on DDG 76 and follow-on new construction surface combatants.
- The ultra high frequency (UHF) enhanced position location reporting system (EPLRS) is a LOS, data-only, digital radio that provides the communications backbone for the tactical internet at brigade and below levels for both the Army and the Marine Corps. It is the primary means of near real-time data distribution for sensor-to-shooter links. EPLRS employs an automated "netting" capability as long as each radio is within sight of at least one other EPLRS unit active in the net. EPLRS are installed on all large deck amphibious ships as part of the AN/KSQ-1 amphibious assault direction system as a standalone system. EPLRS is not currently programmed for installation in any surface combatant. EPLRS can also be used as a UHF relay facility to extend ranges OTH.
- High frequency (HF) radios are available to both maneuver forces and surface combatants but are limited by bandwidth and data transmission rates. HF transmissions are highly susceptible to atmospheric conditions, jamming, and counter detection.
- UHF satellite communications (SATCOM) radios are installed in all surface combatants and available in limited numbers to forces operating ashore. Although fleet battle experiments have demonstrated an OTH capability using this equipment, maneuver forces cannot employ SATCOM while moving due to the directional nature of the antennas that must be used. Employment requires users ashore to stop, set up the necessary ground terminal, acquire the satellite, establish communications with forces at sea, transmit/ receive as needed, and when complete, tear down the terminal before moving again.
- Extra high frequency (EHF) SATCOM radios are installed in all surface combatants, available in limited numbers to forces operating ashore, and subject to the same limitations as UHF SATCOM radios. Additionally, Navy EHF SATCOM terminals are interoperable with those procured jointly by the Marine Corps and Army only in the low data rate (2400 bps) mode.

It is anticipated that at some time during the time period covered by this document (2005–2015) the joint tactical radio system (JTRS) will be fielded. JTRS is a follow-on system for existing radios (VHF, UHF, and HF) that provides reconfigurable waveforms. JTRS will also enhance joint interoperability of these communications systems.

Surface combatants lack an adequate communications capability to operate in support of maneuver forces operating ashore. Airborne relay capabilities for both UHF and VHF LOS radios have been demonstrated in exercises such as Extending the Littoral Battlefield (ELB). The follow-on Office of Naval Research (ONR) effort is known as JTF Warnet and will include a prototype to be deployed on a 7th Fleet expeditionary strike group (ESG) and carrier strike group (CSG) during 2004. There is no funded program to transition either JTF Warnet or the ELB technology to provide the necessary

airborne relay capability, although JTRS may include this. Cancellation of the VTUAV program, with its potential to carry an airborne relay package, further exacerbated this problem. Additionally, neither the architecture nor the requirements have been developed by the services to support this capability.

The services need to develop an operational requirement for an airborne relay for LOS transmissions and provide funding to field this capability to both forces at sea and maneuver units operating ashore. Additionally, an analysis needs to be conducted to determine whether EPLRS should be integrated into the SACC automation and/or installed in land attack capable surface combatants.

5.3.3 Interoperability

The distributed nature of future naval operations and the extended ranges of warfighting require wide bandwidth, low latency, with a secure, robust, redundant, long-range data transfer capability. Data transfer capabilities are essential to exchange command and control data and to build the knowledge and understanding required to conduct the information-based warfare of the future. Furthermore, these capabilities are necessary to develop a common shared awareness of the battlespace that will enable innovation, initiative, and decisive operations.

5.3.4 Bandwidth and Security

The network should have sufficient bandwidth to support the various types of communications needed at all echelons. This includes voice, text, raw and processed digital data, imagery, and video. These communications will require a multi-level security structure employing encryption systems for sharing data between allied and coalition forces. Secure firewalls will also be employed to prevent unauthorized intrusion.

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6.0 COORDINATION OF FIRES

Naval forces plan and execute naval fires in direct support of naval and joint forces performing assigned missions. Naval fires include, in part, strike missions and fire support missions. The naval air, surface, and submarine combat arms will contribute to both of these missions. This chapter discusses existing as well as new concepts for coordinating these fires across naval and joint assets.

6.1 INTRODUCTION

Historically naval operations against targets and objectives ashore have been classified as strike warfare or naval surface fire support (NSFS) and are planned and executed by two different agencies. Land attack warfare is a new construct that has been proposed in order to draw attention to two issues in this regard: (1) greatly expanded and integrated surface combatant capabilities to engage targets and support maneuver forces ashore; and (2) tighter integration of surface combatant capabilities with naval fires as an effective warfighting capability.

Joint Publication 1-02 defines fire support coordination as "the planning and executing of fire so that targets are adequately covered by a suitable weapon or group of weapons." Within the construct of joint fires coordination this concept of operations uses two additional terms that are not defined in joint publications: integration and deconfliction. Integration is a proactive means of planning and executing fires to achieve the synergistic effects of combined arms. Deconfliction is a reactive measure used by exception to arbitrate gaps in the integration of fires, and accommodate changing priorities as friendly forces encounter the fog of war.

6.1.1 Background

New land attack weapons will operate in every part of the battlespace. Successful operations with these capabilities follow informed, responsive planning activities to coordinate operations across the battlespace and electro-magnetic spectrum. This will necessitate improved fires coordination, especially in the joint warfighting environment. Changes in doctrine, tactics, techniques, procedures, equipment, and training will be required to achieve the successful coordination of naval fires in the future.

Coordination of NSFS operations with the overall fire support plan has traditionally been accomplished by the supported maneuver commander who then issues an order to fire to the surface combatant. With the introduction of new land attack weapons and their enhanced ranges, surface combatants will not only be able to deliver NSS fires against deep targets beyond the area of operation (AO) of the land component commander or the amphibious objective area (AOA) far into the joint force commander's (JFC's) deep battlespace, but will also be able to deliver long range NSFS in support of land or amphibious maneuver forces. Coordination with the joint force air component commander (JFACC) and land and maritime components whose airspace these fires will traverse will be particularly important especially for non-ballistic flight profiles.

The supported maneuver commander may not have all the information or authority required to coordinate the fire mission independently. The Aegis air warfare coordinator and the force air defense commander, for example, each have another part of the fires picture necessary for a successful fires coordination capability.

Naval fire support and naval strike resources typically include air-to-surface, surface-to-surface, and subsurface-to-surface delivery assets. It also

frequently includes nonlethal and disruptive operations, such as electronic warfare. In order to maximize combat power, we must use all the available resources to best advantage. Combined arms is the full integration of arms in such a way that to counteract one, the enemy must become more vulnerable to another. Regardless of the attack system or systems employed, naval fires require detailed airspace and ground coordination. Adding to the challenges noted above is the fact that fires are the synergistic product of three subsystems: target acquisition, command and control, and attack resources.[1] Successful fires depend on detailed coordination of these subsystems. Coordinating the processes and procedures of all three subsystems binds fires resources together so the effects of each asset are synchronized to support the commander's intent and concept of operation.

Naval fire support assets used within the joint environment must be fully coordinated with other non-naval fires. This not only includes all other joint fires, but also other naval weapons such as Tomahawk that are typically allocated by the joint force commander. This point highlights the complexity that long-range precision weapons add to the fires coordination problem. Simply stated, not all weapons launched from a naval asset are supporting naval forces. In order to achieve this type of complex coordination among different component commanders, a high degree of joint functionality is required in fires personnel, systems, and procedures. This joint functionality will require a shared, automated picture of the battlespace and changes to the procedural methods currently employed by fires personnel, agencies, and commanders.

A key aspect of this coordination problem is the inability of the air defense command and control (C2) systems to communicate with the land attack C2 systems. The potential of hundreds of land attack assets per hour transiting through controlled air space could lead to their misidentification and engagement by the air defense forces. ***Procedures need to be centrally controlled in order to decentralize coordination and execution of all fires.*** Eventually the air and land tactical pictures should be combined so that the predicted launch times and flight paths of the land attack weapons will be automatically consolidated into the air defense picture.

Expeditionary fire support requires an integrated system or family of systems compatible with on-scene or arriving joint forces. All components of expeditionary fire support must work together throughout the entire planning and execution process. Given the joint nature of future operations, a re-examination of traditional command relationships is required to make these relationships more responsive and flexible.[2] Effective naval fires requires that the commander responsible for the mission or for a phase of an operation has the ability to plan, allocate, control, and coordinate fires from all available systems. Since that responsibility may shift between the Navy and landing force commander during operations, the transition must be seamless and effective. This means that information must be shared, and air and surface fires coordinated, not only between the Navy and the landing force, but also with higher, adjacent and joint units.

6.1.1.1 Workshop Analysis

The October 2001 workshop examined the coordination of future naval fires. A scenario-based vignette was used that emphasized joint task force (JTF) and joint fires architecture. Scarce resources associated with the vignette required that the JTF request support from the JFC and that the JFC required resources from the JTF. Issues such as which agency conducts targeting, selects weapons, assigns shooters, and coordinates fires were discussed. Four basic situations were examined. The first situation required fires within the JTF joint operating area (JOA), and

[1] For more detailed discussion, refer to Chapter 3.

[2] A notional structure for these new C2 relationships is provided in Chapter 4.

the JTF commander had the assets to engage the target. The second situation required the JTF commander to attack targets outside his JOA as directed by the JFC with JTF assets. The third situation required fires to be delivered on targets in the JTF JOA by higher authority with assets/ weapons that were not organic to the JTF. The fourth situation required the JTF commander to request fires from external assets. Regardless of the weapon employed, boundaries inside and outside the JOA required detailed coordination.

6.1.2 Problem Statement

Proper coordination of fires includes those systems internal to the firing unit as well as those external systems with which the firing unit must be interoperable. In order to conduct this assessment, there is a requirement to use joint terminology, but without being constrained by current doctrine. Most of the existing doctrine and tactics, techniques, and procedures have been developed to support air operations. There is a requirement to identify and address issues such as when to rely on procedural methods vice positive control. These concepts can be tested in future exercises. Additionally, this chapter will address current and planned capabilities and identify gaps. Multi-mission capable surface combatants can be tasked to perform traditional NSFS missions while concurrently being tasked by the joint commander to conduct naval surface strike (NSS) missions. The same operators, systems, and weapons will be used to perform both missions. These concurrent taskings blur the distinctions between these missions and require more sophisticated agencies and systems to achieve proper coordination of all fires.

Before a naval fires asset transits through another agency's controlled air space, its mission and flight profile must be coordinated with the controlling agency. Air space coordination consists of the following:

- The asset must avoid interfering with other systems,
- The asset must avoid interference by other systems, and
- The asset must avoid causing friendly casualties.

Two new key aspects of air space coordination are fratricide of the weapons and management of the air space between the firing ship and the maneuver commander. Correct identification of some friendly naval fires assets is further complicated by the following:

- The weapons have no identification friend or foe (IFF) capability,
- The weapons may fly dogleg profiles to the target making their point of origin unknown,
- Precision guided weapons may not follow their predicted trajectories, and
- Tactical Tomahawks have the ability to fly a loiter pattern and can be retargeted in flight.

Commanders exercise authority within the four dimensional limits of boundaries established by a higher headquarters. The commander has target identification and engagement authority for organic weapons and is responsible for the effects of all fires delivered into or within these boundaries. Once these boundaries have been established, the command and control of fires is a function of the fire support coordinator within whose boundaries the effects of the fires will be realized. This includes coordination with adjacent units whose battlespace is affected by the flight path or terminal effects of the weapons system/munition. Any adverse effects of NSFS delivered on a requested target are the responsibility of the requesting agency, not the commander of the ship who provided the fires. This also requires a change to traditional weapons release and engagement authority.

The techniques and procedures for command and control of fires throughout an extended joint littoral battlespace will continue to evolve. Weapons systems with extended horizontal ranges, high altitude apogees, variable flight paths, and

on-station loiter times will present greater challenges to commanders exercising command and control of fires. These weapons systems can be expected to cross multiple unit boundaries, fire support control measures, and other battlefield geometries en route to their designated targets. The employment of these new weapons will require detailed fire planning, coordination, and synchronization[3] of fires among commanders and their staffs in near real-time.

The remainder of this chapter will deal with coordinating fire support and strike during standard missions and attempt to address the management of the battlespace geometry.

6.2 JOINT NATURE OF FIRES

To achieve proper coordination and synchronization of fires, it is necessary to specify how a commander joint task force (CJTF) interacts with the component commanders designated by the JFC. This will help resolve issues such as the relationship between the joint air operations center (JAOC) and the joint fires element (JFE). Under current doctrine the JFE is an advisory/ liaison agency and lacks the execution, monitoring, personnel and equipment capabilities to provide a real-time air picture and corresponding fire support coordination capability. Some hybrid JFE type agency with the proper functionality will be required for future planning, coordination, and execution of fires. An agency, such as the JFE, operating with the authority of the CJTF/JFC will ensure that targeting, planning, integration, and deconfliction are in accordance with the commander's intent and operate with a complete picture of the battlespace. The functions and required operational capabilities for this organization need to be identified. The planning function of this agency is particularly important because the more time spent on fire integration the less time will be required for deconfliction. This is an essential point. Deconfliction is reactive and is used when deviating from the integrated fire plan. Fire coordination, to include integration and deconfliction, is a continuous process.

6.3 NAVAL FIRES

Naval fires consists of naval fire support and naval strike. Naval fire support for expeditionary warfare in the littorals is generally recognized today as those fires consisting of naval guns, missiles, close air support, and non-lethal fires within defined boundaries and short of the fire support coordination line (FSCL). Naval surface fire support is just one piece of naval fire support. Naval strike has historically been characterized as those fires delivered beyond the FSCL or when no FSCL has been established. In future operational concepts of STOM and OMFTS, an FSCL may or may not be established. Weapon system ranges and effects-based targeting blur the distinction between naval strike and naval fire support. The surface fleet needs to be able to coordinate fires with aviation and Tomahawk assets to provide a scalable set of effects on the land battle. These effects range from a single precision missile strike to a sustained barrage and include both lethal and non-lethal effects."[4] The effect for the maneuver commander should be transparent, that is, fires should meet his intent whether the shooter is a ship, an aircraft, or an artillery battery. This does not diminish the importance of the unique characteristics inherent in each fire support system when addressing specific targets. Transparency of fires will be joint in nature by including all assets within and outside the operating theater.

Future joint fires will be characterized by the overall desired effect of those fires on the enemy and not by the specific weapons system being employed. Complementary effects of specific weapons systems must be understood and used

[3] The arrangement of military actions in time, space, and purpose to produce maximum relative combat power at a decisive place and time. Joint Pub 1-02

[4] NWP 3-09.1, *Navy Strike and Fire Support* (Draft), dated 6 February 2002, para A.2.2.

in the planning and coordination of naval fire support with all other joint fires and during the development of the fire support plan. The Navy needs to commit to building architecture that coordinates all fires to provide this transparency of fires.

> "It has become clearer with each fleet battle experiment the future naval offensive and defensive capabilities quickly overwhelm the current naval capability to perform detailed planning for their use—both at the tactical and the operational level" NWP 3-09, A.4.1.2.

6.4 CONCEPT FOR THE COORDINATION OF FIRES

6.4.1 General

The concept for the coordination of fires needs to articulate the problem in terms of integration and deconfliction (both procedural and dynamic). Command relationships play a key role in the planning for the coordination of fires. All components can plan and coordinate fires. During different phases of an operation, command relationships may change such as supported/ supporting relationships. For instance, during pre-assault operations, COMNAVFOR could be designated as the supported commander.

The Joint Publication 3-09, *Doctrine for Joint Fire Support*, states, "The key to effective integration of Joint fire support is the thorough and continuous inclusion of fire support in the planning process and a vigorous execution of the plan with aggressive coordination efforts. The purpose of joint fire support planning is to optimize its employment by integrating and synchronizing joint fire support with the supported commander's maneuver plan."[5]

6.4.2 Procedural Fires Coordination

Procedural fires coordination is the implementation of preplanned fire coordination measures for the entire battlespace. These measures facilitate the execution of fire plans, minimize real-time deconfliction of fires, and contribute to achieving transparency of fires. The result is a more effective and timely execution of fires.

Procedural fires coordination can become more complex when long-range high trajectory and/or loitering munitions are added to the mix. The various components and agencies involved in a joint operation can be informed as to the preplanned activities of each other, however they do not have the picture of what is actually being executed. One issue is whether or not the JFE has the full view of the fires that are being planned and executed and, if so, using what systems?

Procedural fires coordination is further complicated by the use of various weapons systems that require interaction with different agencies such as the tactical air command center for air support, the TLAM strike coordinator for Tomahawk, and the supporting arms coordination center (SACC) for NSFS. Additionally, the SACC may be limited to integrating fires within the purview of the joint force maritime component commander and that agency's authority may not extend into the adjacent joint battlespace. For instance, if a JFC asset fires a land attack missile into the JTF battlespace, procedures must be developed to coordinate this mission with all affected agencies. Procedural measures alone will not resolve all fire support coordination issues.

6.4.3 Real-Time Fires Coordination

The real-time coordination of fires depends upon the creation of the single integrated air picture (SIAP). SIAP is not expected to be available

[5] Joint Pub 3-09, *Doctrine for Joint Fire Support*, dated 12 May 1998, page 3-1.

before the 2015 timeframe as covered by this CONOPS, but is discussed here for completeness. SIAP will provide a single continuous real-time track and positive identification for all airborne objects within joint sensor range. This real-time air picture will: (1) enable dynamic four-dimensional deconfliction of long-range, high-altitude ordnance and aircraft flight paths, (2) provide track and identification information to joint air defense networks to prevent an inadvertent response to friendly air assets, and (3) enable force self-synchronization to increase speed of command and accelerate mission execution. Self-synchronization is the capability of a well-informed force to coordinate complex warfare activities from the bottom-up, instead of the traditional top-down approach. For example, a manned aircraft conducting a time critical strike mission would be instantly notified if the aircraft's current track would potentially intersect the predicted future flight path of any other airborne object. Any flight path conflicts would prompt the system to recommend a corrective action to the pilot.

It is important to note that the SIAP will minimize, not eliminate, the need for airspace control measures. Some control measures will always be required because: (1) tracking and bandwidth resources will always be limited, especially in the congested littoral environment; (2) safety will always be a concern; and (3) backup measures in case of system failure must always be available. A step in developing the SIAP is the cooperative engagement capability (CEC), which integrates sensors and fire control systems into a common tactical picture.

6.4.4 Near Real-Time Procedural Coordination (NRTPC)

Improvements in procedural coordination must be pursued as the primary solution until a real-time coordination capability is available. Procedural coordination needs to be provided in near real-time allowing for opening and closing corridors and bubbles around targets and weapons enroute. As tactics, techniques, and procedures are developed and shared situational awareness improves, the timeframe for accomplishing this should approach the 5-minute update range. There is no specified agency that has the authority, capability, and systems to properly execute this process of NRTPC in support of the JFC. New capabilities require the merger of procedural measures with the real-time picture. Aegis has a capability to overlay airspace coordination measures onto real-time track information. However, there is no current requirement to integrate maneuver control and fire support coordination measures within Aegis. The complete implementation of NRTPC will require the continued development of technology to reduce the latency of information and enhance the effectiveness of procedural coordination to integrate and deconflict joint fires and the real-time control of assets.

Unit boundaries and fire support coordination and control measures can be safely expanded both seaward and inland to encompass the increased ranges of weapons systems available to the battlespace commander with an enhanced coordination capability.

Implementation of the NRTPC concept requires that a single authority exercise coordination of all fires within the designated boundaries of the battlespace. This coordination function includes all ground, naval surface, subsurface, and air delivered fires, as well as non-lethal operations. A naval fires coordinator (NFC) will be designated with the authority to integrate all naval fires with all other joint fires.[6] Depending on the requirements of the operation, the NFC may be assigned to either Navy or Marine Corps control. The NFC may be located in the carrier intelligence center (CVIC), the SACC, or the FFCC where the existing capabilities of these agencies can be employed to perform this function.

[6] See section 4.3.1 for a description of this notional command structure.

The NFC must be supported with the appropriate personnel and command, control, communications, computers, intelligence, surveillance, reconnaissance, and targeting (C4ISRT) assets to provide the level of coordination necessary for a given operation. It may be necessary to establish a separate naval fires coordination cell (NFCC)[7] to peform this function. Until a real-time coordination capability is fielded, the NFC requires the automated capability to manage battlespace geometries to arbitrate conflicts in their use.

[7] NFC and NFCC are further discussed in Appendix C.

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7.0 PLANNING, TARGETING, AND EXECUTION

The effectiveness of future naval surface fires will be enhanced through a streamlined continuous loop process that includes mission planning, target acquisition and development, execution, and assessment. This process emphasizes an effects-based[1] approach to warfare that is focused on achieving commander's objectives by all available means with the least risk, time, and expenditure of resources.

7.1 INTRODUCTION

Land attack warfare involves the coordinated use of all available joint planning, targeting, and execution assets. These individual systems must be able to function as one overall land attack system-of-systems, capable of rapidly and efficiently conducting this mission area. For example, target data from disparate space, air, and ground sensors must be readily accessible to the proper command and control systems to facilitate the targeting process. This target data must then be efficiently distributed to the various weapon systems to facilitate mission planning, assignment, and execution. In addition, weapon delivery information must be coordinated with battle damage assessments to complete the loop back to command and control for mission evaluation.

7.2 PLANNING

Land attack planning starts with rules of engagement and commander's guidance, and includes attack analysis, scheduling fires, preparing for attacks against targets of opportunity and time critical targets, coordinating assets, positioning assets, allocating communications resources, providing combat service support, and computing firing data. In the past, much of this planning effort has been done manually at various levels of the command structure.

Land attack planning conducted at the joint force commander (JFC) level optimizes employment of fires by integrating and synchronizing them with the supported commander's concept of operations and scheme of maneuver. Targets are selected for their tactical, operational, and strategic values. Ground component commanders prepare fire support plans and determine the requirements for close air support, naval surface strike (NSS), naval surface fire support (NSFS), field artillery, and mortars. The desired effect on the target, as well as the potential for collateral damage around the target, are major considerations in selecting the weapon type and amount of munitions.

Targeting teams assist the commander by synchronizing operations, recommending targets to acquire and attack, and evaluating battle damage assessment (BDA). Fire support planning at the maneuver element commander's level concentrates on identifying on-call targets, integrating fire plans with the scheme of maneuver, and executing fire plans.

The Navy's global command and control system (GCCS-M) will provide common situational awareness data and information to land attack command and control elements and engagement planners via the common operational picture (COP). The COP will display current battlespace information in a graphical manner through links to detailed operational data and information.

7.2.1 Naval Surface Fire Support

NSFS missions may be performed by any of the onboard weapon systems. Coordinating NSFS with the movement of forces ashore will become increasingly complex. The MV-22 tilt-rotor assault transport and the advanced amphibious

[1] Joint Pub 3-60, *Joint Doctrine for Targeting*, page I-4.

assault vehicle (AAAV) will enable faster and longer ranging maneuver force capabilities. As a consequence, the increased range of the new land attack weapons supporting OMFTS will require rapid time-space coordination and deconfliction across a much larger battlespace. With the introduction of new mission planning and coordination systems and the mobile ground combat operations centers (COCs), fire planning will become more responsive to the maneuver commander.

The naval fires control system (NFCS) is the surface combatant's land attack mission planning and coordination system that will provide digital connectivity between the shipboard land attack systems and the off-board land attack command and control systems. The initial NFCS configuration consists of installed hardware and software that can operate on any of the four TTWCS consoles. NFCS mission tasking may be received from shipboard targeting systems or from off-board sources such as a supporting arms coordination center (SACC), a fire support coordination center (FSCC), a fire support element (FSE), or a forward observer. NFCS also allows land attack personnel to manually input information received from voice radio circuits. Planning for TACTOM as a fire support weapon will be accomplished via the TTWCS system as discussed in the following section.

7.2.2 Naval Surface Strike

Naval surface strike (NSS) missions may be performed by any of the onboard weapon systems. For most NSS missions, Tomahawk is the weapon of choice and will be until other systems are fielded, such as the extended range guided munition (ERGM), long-range land attack projectile (LRLAP), and advanced land attack missile (ALAM).

The Tomahawk missile system uses both the cruise missile support activities (CMSAs) and afloat planning system (APS) detachments to plan the route and flight profile for Tomahawk land attack missile (TLAM) missions from the first preplanned waypoint to the target. These agencies provide the expertise and equipment necessary to fully employ the unique capabilities of the Tomahawk missile to support the regional combatant commander or joint force commander. APSs have the ability to plan conventional TLAM missions end-to-end, as would a CMSA, but on a much more limited basis. They also generate new missions by modifying existing ones contained in their master mission library. APS is designed to provide the battle force/ battlegroup commander operational flexibility by quickly generating some missions as a rapid response to emerging targets.[2]

The Tactical Tomahawk (TACTOM) weapon control system (TTWCS) aboard surface combatants is capable of planning strategic, operational and tactical missions for the TACTOM missile, while retaining the preplanned mission capabilities of earlier missiles.[3] In addition, the TACTOM missile, when placed in a loitering mode, may be used as a quick response weapon against time critical targets. The shipboard Tomahawk weapon system, using the launch platform mission planning function, will provide this responsiveness by speeding the mission planning process, taking into account airspace control requirements and fire support coordination measures through use of manually entered no fly/must fly areas, and reducing the probability of attrition by avoiding known threats. TTWCS will interface with existing and evolving land attack and fire support systems to support the tactical mission objectives.

[2] APS will transition to strike planning cells in 2004.

[3] Refer to the *Tomahawk Weapon System Baseline IV Phase 1 Command, Control, Communications, Computers & Intelligence Support Plan (C4ISP)* for a more detailed account of the employment of the Tactical Tomahawk.

7.2.3 Munitions Loadout

The surface combatant of the 2015 timeframe will have a variety of munitions that can be used in support of land attack warfare. Ships will have 5-inch and 155mm gun systems that will deliver ballistic and guided munitions against targets ashore, as well as vertically launched Tomahawk cruise missiles and an advanced land attack missile. A key consideration will be to maximize use of available weapon storage/ carrying capacity while maintaining the capability for the combatant to meet all of its assigned multi-warfare mission area requirements. The munitions loadout mix must be carefully tailored to both meet the specific threat requirements in the combatant's assigned area of operations, as well as to maintain the flexibility to meet any unexpected threats that may arise.

The loadouts for the naval gun systems will depend upon the mission areas allocated to the guns on each type of ship. Three mission areas have been identified for the 5-inch/62-caliber guns on the Aegis cruisers and destroyers: NSFS, surface warfare (SUW), and anti-air warfare (AAW). On the DD(X) ships, the 155mm gun system is expected to provide capability in NSFS and SUW. Although the gun systems are primarily a fire support weapon for troops ashore, they also have the capability to attack most operational and strategic targets within range.

The loadouts for the Tomahawk weapon system and the advanced land attack missile[4] will depend on anticipated preplanned and tactical mission requirements for satisfying land attack mission objectives. Both missiles will provide capabilities against a wide variety of tactical, operational, and strategic targets, and will be capable of meeting rapid response times against time-critical targets.

The Mk 41 vertical launching system (VLS)[5] is the storage and launching system for the Tomahawk cruise missile, the air-defense standard missiles, the vertical launch anti-submarine rocket, and the evolved sea sparrow missile. The number of VLS cells available on a ship must accommodate a mix of weapons designed for different offensive and defensive missions. Because of these competing demands, the actual number of land attack missiles per ship will be significantly less than the total VLS cell capacity, and will be determined by their availability and the requirements for the other VLS-launched weapons.

Land attack planners also need to consider and schedule missile and ammunition replenishment of surface combatants. This is particularly important when the tactical situation may involve sustained operations ashore, as the extended range of the new land attack weapons will increase the likelihood that they will be employed for the duration of the operation. Reliance on sea-based land attack weapons may significantly increase if the troops ashore require high mobility and maintain only a minimum of shore-based fire support assets. These factors must be considered when estimating replenishment needs for the land attack combatants.[6]

7.2.4 Allocation and Control

Higher command echelons may allocate land attack resources, including gun-launched munitions and VLS launched missiles, for specific uses or among subordinate components or commands. Guidance on gun-launched munition allocation will most likely be provided the commander, amphibious task force; commander, landing force; or a corps commander, although the supported land or naval force commander may also provide inputs.

[4] There is currently no defined program for the advanced land attack missile.

[5] Mk 41 VLS is a below-deck launching system comprised of 25-foot-high launching modules. It is installed on all Aegis combatants except the Baseline 1 cruisers (CG47–51).

[6] Chapter 8 covers logistics in detail.

The JFC may reserve a specific number of Tomahawk missiles to achieve specific operational and strategic effects. Some Tomahawk missiles may also be allocated to subordinate commanders for tasking and employment. Although normally assigned to deep strike and interdiction targets, Tactical Tomahawk missiles may also be allocated to a maneuver unit and be employed in direct support. Scheduling would be on the air tasking order (ATO) in a manner similar to close air support.

At the tactical level, commanders may further allocate fire support resources by assigning priority of fires. Priority of fires is usually assigned to the unit designated as the main effort, and provides guidance to a fire support planner to organize and employ available fire support assets.

7.2.5 Stationing

Surface combatant stationing is another important consideration in the employment of land attack resources. The naval commander will need to consider his multi-warfare mission requirements along with the number and specific capabilities of each assigned surface combatant. The following paragraphs cover some of the typical considerations that must be taken into account.

Fire support areas (FSAs) are maneuver areas assigned to fire support ships. Fire support stations (FSSs) are exact locations within a FSA. With the added range and flight characteristics of the new land attack weapons, the positioning of the fire support ships will be less constrained by such things as the gun target line (GTL), ship maneuvering room, and obstacles. However, GTL considerations may still be a factor when high-volume/long duration suppression fires using low-cost ballistic munitions are needed.

Ship stationing is also an important consideration for controlling the firing of munitions across boundaries. Proper stationing can reduce the challenge of fire support coordination by limiting the volume and complexity of airspace requiring deconfliction. Communications connectivity should also be considered when stationing surface combatants. Depending on the communications frequency and satellite footprints, ships may need to be repositioned to maintain connectivity with the units maneuvering ashore.

Tomahawk launch baskets are stations from which the surface combatants launch TLAMs. The missile must be launched to meet the specific mission requirements.

7.2.6 Mission Effects

Land attack missions are categorized by the desired effect. This categorization provides a clear description of the land attack mission being planned and executed. A number of factors must be considered when selecting the appropriate weapon for attacking a target:

- Nature and importance of the target
- Engagement time window
- Target dwell time
- Availability and location of attack assets
- Range to target
- Location of target
- Target location error
- Desired mission effects
- Potential collateral damage

Table 7-1 lists the mission effects for NSS and NSFS, and provides a short definition of each mission effect.

Table 7-1. NSS and NSFS Mission Effects

Mission Effect	Mission	Definition	Considerations
Destruction	NSS/ NSFS	Fires delivered for the sole purpose of destroying the target's combat effectiveness.	Land attack munitions utilizing precision guidance systems for navigation, target location and weapon guidance, carrying submunitions or unitary blast fragmentation payloads, can be accurately delivered and effective against a wide range of targets. Some targets may require a high volume of fires to achieve destruction.
Neutralization	NSS/ NSFS	Fires intended to render the target temporarily ineffective or unusable.	Land attack munitions utilizing precision guidance systems guidance can be effective and accurately delivered to quickly neutralize targets that may be difficult to destroy.
Suppression*/ SEAD	NSS/ NSFS	Fires placed on or about a weapons system** which degrade its performance below the level needed to fulfill its mission for some period of time.	The long range, high accuracy and predictable time-on-target delivery of land attack munitions may be suitable for SEAD or short duration suppression missions. The relatively high cost of precision-guided munitions may limit their usefulness in volume fire missions.
Interdiction	NSS/ NSFS	Fires placed in an area to divert, disrupt, delay, or restrict the enemy's freedom of movement or prevent the enemy from using the area.	The long range and accuracy of land attack munitions may be suitable for interdiction missions. The relatively high cost of precision-guided munitions may limit their usefulness in volume fire missions.
Harassing	NSFS	Fires designed to disturb the enemy's rest, curtail movement, or lower morale.	Land attack munitions can be used in conjunction with aircraft, artillery and mortars to effectively provide harassing fires. Low cost ballistic munitions can be used over extended periods to provide sustained effects.
Screening or Obscuration	NSFS	Fires used to conceal friendly maneuver elements or suppress the enemy by obscuring his view of the battlefield.	NSFS high explosive or white phosphorus rounds are available to achieve this mission effect within the ballistic range capability of the gun system.
Illumination	NSFS	Fires used to allow observation of enemy operations and movement during periods of reduced visibility.	NSFS can deliver illumination out to the ballistic range of the gun system.

* Suppression includes counterfire/counterbattery.
** Weapons system is a combination of one or more weapons including all related equipment, materials, services, personnel, and means of delivery and deployment.

7.3 TARGETING

Targeting is the process of selecting targets and matching the appropriate response to them, considering operational requirements and capabilities. Strategic, operational, and tactical objectives dictate targeting priorities. Tactical targeting is based on the friendly scheme of maneuver and the fire support capabilities at the commander's disposal. Targeting includes an assessment of the weather, terrain, and the enemy's situation, and identifies enemy units, equipment, facilities, and terrain that must be attacked or influenced to ensure success. The emphasis of targeting is on identifying resources (targets) the enemy can least afford to lose or that provide him with the greatest advantage. Targets must be detected, accurately located,[7] identified, and prioritized for effective attack. Maneuver, fires, electronic attack, or a combination of these may be used to attack the selected targets.

[7] The GPS guidance systems use the WGS-84 datum. All targeting data must be referenced to this datum.

7.3.1 Targeting Process

Joint doctrine and existing service planning procedures for the acquisition, selection, and attack of targets have four common stages:

- **Decide** in advance what is to be targeted
- **Detect** the target
- **Deliver** an attack against it
- **Assess** the results of the attack

This targeting process shown in figure 7-1 represents the effective integration of command and staff activities, intelligence systems, and weapons systems. The targeting process is the same whether the targets and objectives are strategic, operational, or tactical, and is not tied to any particular weapon system. The phases shown in the diagram are not separate segments, but instead, blend into each other and are continuously updated and adjusted.

Among many factors that must be considered during the targeting process, two key factors are the target location error (TLE) and the target dwell time. The TLE describes the error inherent in the process of locating a target. Every target acquisition sensor has some inherent error that drives the total TLE. If the TLE is unknown, the type of sensor used to locate the target should be included in the mission report in order to estimate TLE. The dwell time is the length of time a target is expected to remain in one location. For effective engagement of stationary mobile targets, the anticipated dwell time of the target, the time of detection, and the overall response time of the system must be considered. Therefore, data time tags and target dwell time estimates are essential parts of the targeting data.[8]

7.3.2 Targeting Products

Several products are generated during the targeting process that assist the commander in accomplishing his operational objectives, and help him set criteria to be used. These products include the high payoff target list (HPTL), the attack guidance matrix (AGM), and the target selection standards (TSS).

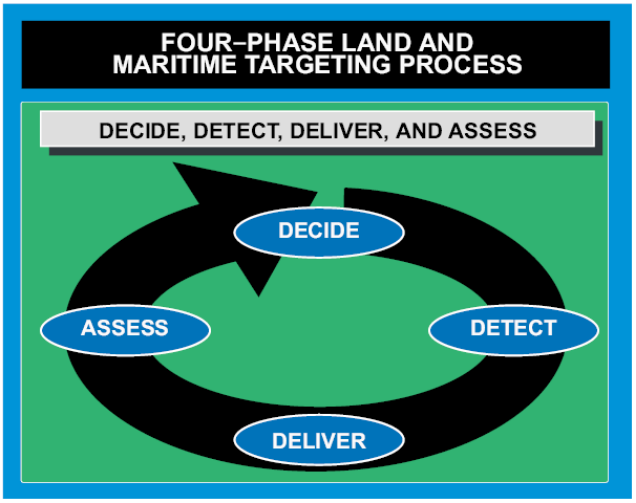

Figure 7-1. Targeting Process

7.3.2.1 High Payoff Target List (HPTL)

High payoff targets are targets that, if successfully attacked, would contribute substantially to friendly operations. The HPTL prioritizes these targets to reflect the commander's precedence list and the threat. Table 7-2 is an example of an HPTL.

Table 7-2. High Payoff Target List

Priority	Target Set	Tgt Sheet Number	Description
1	1	29,34	Division CP
2	2	1,2,18	Arty Bn FDC, Cmd OP, FA Btry

7.3.2.2 Attack Guidance Matrix (AGM)

The AGM condenses the staff and commander's decisions for attack of planned targets and targets of opportunity. Included in the AGM is a prioritized list of high payoff targets, when and how the target should be attacked, the desired effect of the attack, and any special instructions or requirements for BDA. The AGM provides

[8] For a more detailed description of the targeting process, see Joint Pub 3-60, *Joint Doctrine for Targeting*, 17 January 2002, and Joint Pub 3-09, *Doctrine for Joint Fire Support*, 12 May 1998.

an easy to read single source document for most of the targeting information. Table 7-3 is an example of an AGM.

Table 7-3. Attack Guidance Matrix Phase/Event

HPTL	When	How	Effect	Remarks
Cmd OPs	Prep	ERGM	Neutralize	Plan in initial prep
MLR Battery	Assault	TACTOM	Destroy	
SA 13/ SA 9	Prep	ERGM	Neutralize	SEAD for Aviation Ops

7.3.2.3 Target Selection Standards (TSS)

The TSS are the criteria the targeting team uses to differentiate actual targets from suspected targets. The TSS considers attack system requirements, target characteristics (size, activity, etc.), and the timeliness of the targeting information. Table 7-4 is an example of TSS.

Table 7-4. Target Selection Standards (TSS)

HPTL	Attack System	TLE/Acq Time
MLR Battery	TACTOM	< 100m/10 minutes
Cmd OPs	ERGM	100m/2 hours
Armor	CAS	1km/2 hours

7.3.3 Target Types

7.3.3.1 Point Target

A point target is one of such small dimension that it requires the accurate placement of ordnance to neutralize or destroy it. Examples of point targets are mobile guns and missile launchers, single vehicles, aircraft shelters, and bunkers.

7.3.3.2 Area Target

An area target consists of a very large object or a set of target elements distributed over an area. Area target examples are enemy formations or materiel targets such as armored formations, truck parks, ammunition dumps, petroleum/oil/lubricant (POL) dumps, and communication centers. Using predetermined fire patterns or sheafs[9] allows land attack weapons to effectively engage area targets. It is important to define the size and shape of an area target to ensure accurate engagement.

7.3.3.3 Moving Target

Moving targets are typically tanks, armored personnel carriers, and other vehicles used by a mechanized ground force. Land attack weapons can be effective against a moving target if the overall movement of the target during time of flight can be reasonably predicted (e.g., movement restricted to a road or transit of a known choke point) or if the target's movement can be stalled temporarily. However, to hit a moving target with a high probability of kill requires a weapon that can either receive last minute precision targeting updates, or has a terminal seeker capability.

7.3.3.4 Planned Target

A planned target is one that is known to exist in an operational area and can be either scheduled or on-call. A scheduled target is included in a fire support plan or ATO for attack during a specified time window. An on-call target is also included in the fire support plan or ATO, but is only attacked when required.

7.3.3.5 Target of Opportunity

Targets of opportunity are targets encountered that were not previously known or planned. When an emergent target is of high value/high payoff or an immediate threat, the fires system must be able to respond expeditiously. This may involve prearranged procedures designed to send targeting data directly from a sensor to the firing unit. Targets of opportunity will continue to

[9] In artillery and naval gunfire support, planned planes (lines) of fire that produce a desired pattern of bursts with rounds fired by two or more weapons.

represent a large portion of the targets engaged at the tactical level.

7.3.3.6 Time Sensitive Target

A time sensitive target (TST) is defined as "Targets requiring immediate response because they pose a clear and present danger to friendly forces or are highly lucrative, fleeting targets of opportunity."[10] A time sensitive target falls into three broad categories:

- One that presents an immediate and significant threat because of its capability, speed, and/or range
- One that is a high priority target that offers a short window of vulnerability
- One that becomes a priority due to its military significance during a particular phase of a conflict

A TST can have importance from a tactical, operational, or strategic perspective. They can be found throughout the battlespace and must be identified and categorized during the planning phase. Normally, the joint force commander establishes time sensitive target priorities during the commander's objective and guidance phase of the joint planning process. Target acquisition assets are then prepositioned to detect and identify the TSTs, and specific weapon systems are reserved to engage and destroy them. Up to now the focus of engaging TSTs has been with aviation assets. Surface combatants can also be integrated into the TST process once new fast response targeting systems and weapons reach the fleet.

Tactical ballistic missile transporter-erector launchers (TBM TELs) capable of delivering weapons of mass destruction represent a serious threat to friendly forces. The problem is compounded by the TEL's ability to quickly emerge from prepared camouflaged or hardened shelters, shoot, and then return to the shelter. These targets may be specifically designated as time critical targets (TCTs) where immediate engagement outweighs other operational considerations.[11]

Many decisions and steps in the attack sequence must be preprogrammed or automated to meet the necessary reaction times for this target category. High priority launch and hide sites will be assigned continuous sensor and weapon coverage. The integrated engagement process will correlate track data and target identification confidence levels to determine suitable sensor-to-weapon-to-target matching, and then communicate the results to the decision makers, if not directly to the weapons. An evaluation of the success of the attack must also be performed so that the TST can be re-engaged as required.

7.3.4 Targeting Sources

The scope of targeting sources ranges from national assets and intelligence for identifying preplanned targets, to forward observers on the ground and in the air to identify targets of opportunity. National and theater level sensors provide data to intelligence processing facilities that in turn provide intelligence support to the fleet. Force planners then develop strategic and operational target lists that are relayed to the appropriate firing unit.

The surface combatant will typically receive missions and primary targeting information from external sources. If performing in the NSS single unit or multi-unit commander role, the combatant may also have the capability to receive raw, unevaluated data directly from an organic or non-organic sensor (e.g., from an unmanned aerial vehicle) and develop precision targeting data.

[10] Joint Pub 1-02, *DOD Dictionary of Military and Associated Terms*.

[11] TCT is a sub-category of TSTs and the differences between them are discussed in Chapter 3.

7.3.4.1 Non-Organic Sources

Non-organic sources of pre-processed targeting information (in the form of mission data) could include a supporting arms coordination center, a fire support coordination center, a force fires coordination center, a fire support element, a strike warfare commander, a surface battlegroup commander, or a joint intelligence center.

Sources of unprocessed targeting information could include national sensors, other intelligence information, the joint surveillance and targeting attack radar system (JSTARS), theater and tactical unmanned aerial vehicles, fixed and rotary winged aircraft, ground force targeting systems such as the target location designation and handoff system (TLDHS), and voice messages.

As mentioned in Chapter 1, the future network-centric battlespace will divide the warfighting problem into a sensor, command and control, and engagement grid. The naval fires network (NFN) will initially integrate the sensor grid elements, overlaying intelligence information from pre-existing databases and multiple real-time air, space, and ground sensors. NFN will integrate the surveillance/reconnaissance pictures and present the resulting information in a form that enables rapid target detection, identification, and localization. This targeting information can then be rapidly transmitted to the command and control, and engagement grids for disposition. NFN will ultimately evolve to a combat systems network, integrating the sensor, C2, and engagement grid elements to achieve time sensitive targeting.

7.3.4.2 Organic Sources

The surface combatant can augment non-organic source information with available organic target acquisition sensors. Organic sources of targeting data can include the AN/SPY-1 radar in a potential counterfire/counterbattery mode, a tactical unmanned aerial vehicle (TUAV) controlled by the ship, a thermal imaging sensor system or electro-optical sight, and an improved LAMPS MH-60R helicopter with an electro-optical sensor and video data link.

> Since publishing the original Conops in July 2001, funding for both the vertical takeoff and landing tactical UAV and tactical control station (TCS) programs has been withheld. Both of these programs are critical to providing combatants the organic capability to conduct land attack warfare as envisioned in the *Naval Transformation Roadmap*. These systems were included in the October 2001 workshop in preparation for this document.

7.3.5 Weapon Employment Considerations

Details on the employment of the individual weapon systems can be found in Appendix B. Table 7-5, at the end of this chapter, summarizes these considerations.

7.4 EXECUTION

7.4.1 Mission Timelines

Various missions have different planning and execution timelines. Surface combatants must have the capability to plan and execute fires to respond to tactical, operational, and strategic mission requirements. These fires must be coordinated with other fires and maintain consistency with the JFC's intent and campaign objectives. Fires delivered in close proximity to friendly forces require detailed coordination with the fire and maneuver of those forces.

Tactical fires are characterized by short response times (2.5 minutes or less) because the targets are immediately threatening friendly forces. Examples include counterfire/counterbattery and final protective fires.

Operational fires are characterized by relatively short response times (tens of minutes to several hours) because the targets have the potential to threaten friendly forces in the near future. They

are normally delivered at some distance from friendly forces. For example, interdiction fires could disrupt or delay enemy reinforcements, thereby increasing the effectiveness of friendly ground operations.

Strategic fires are characterized by long response times (hours or days) because the targets are fixed or are not in a position to immediately threaten friendly forces. Typical targets include enemy centers of gravity or nodes critical to the execution of the enemy's campaign plan.

7.4.2 Commanding Officer's Responsibility

The responsibility of the ship's commanding officer will depend on the role the ship is performing and the existing command and control relationships. This responsibility could vary from simply executing orders to fire received in the NSFS supporting unit role, to performing the surveillance, targeting, mission planning, and mission execution functions in the NSS single unit role. The command and control structure of future surface combatants conducting land attack warfare must be sufficiently robust to support this broad range of responsibilities.

In the NSFS controlling unit and NSS multi-unit commander roles, the surface combatant directing the fires of other ships would probably be the ship with an embarked commander (such as a group commander or DESRON), or a cruiser with an O-6 level commanding officer. The commanding officer takes on additional responsibilities for fires direction and coordination when exercising this role.

Future Marine Corps expeditionary operations will place greater reliance on sea-based support. The surface combatants must be able to sustain the required firepower and C4ISRT support to the forces ashore under all conditions. New weapons systems are being developed to allow the surface combatant to remain over the horizon. However, circumstances may require that the surface combatant approach the shore to extend the range of the fire support assets, reduce projectile time of flight, perform counterfire missions with sea-based assets, or perform search and rescue operations.

7.4.3 Shared Resources

Surface combatants are being upgraded to provide significant new land attack, theater ballistic missile defense, and cooperative engagement capability functionality. However, there are only a limited number of existing consoles and operators available to support these new capabilities, operator training is already too long and complex, and crew sizes may be significantly reduced in the near future.[12]

These new capabilities create demands for flexible manning options such as special support teams, either created from shipboard personnel or brought aboard as mission specific teams, to support the more specialized functional areas. Future reduced-manning platforms may also require personnel to operate across multiple warfare areas. This situation will place additional requirements for cross certification of specialties, and standardized man-machine interfaces and procedures.

Land attack operations require the use of the multi-warfare capable gun, VLS, TUAV, and radar assets. The ship's commanding officer must closely monitor the real-time multi-warfare tactical picture and manage his available assets across multiple mission areas. For example, if an anti-ship missile threat exists the ship may not have the radar resources available to perform the counterfire mission. The nature of the complex littoral operational environment requires careful planning across multiple warfare areas and execution using all shared resources.

[12] See the 'Training Requirements Document' published by the Manpower and Training WIPT for further detail.

8.0 OPERATIONAL SUPPORT

This chapter discusses the Navy logistics process and analyzes a specific scenario to assess the Navy's 2015 volume of fires and sustainment capabilities.

8.1 INTRODUCTION

Chapter 1 identifies Sea Basing as one of the four components of the naval transformation roadmap. Sea Basing enables the accelerated projection, protection, and sustainment of all dimensions of networked naval power, providing joint force commanders with unprecedented speed and flexibility of employment and expanded operational reach. As a primary enabling concept for Expeditionary Maneuver Warfare, Operational Maneuver From The Sea (OMFTS), Ship-To-Objective Maneuver (STOM), and other expeditionary concepts, Sea Basing supports the principles of:

- Preemption or striking with surprise from the vastness of the sea;
- Use of the sea as maneuver space for naval and joint forces;
- Creating and sustaining overwhelming operational tempo and momentum through maneuver;
- Enhancing strategic, operational, and tactical mobility;
- Rapid force closure and at-sea reconstitution;
- Capitalizing on the force protection inherent in the naval command of the sea.[1]

The information set forth in this chapter is relevant to further development of the Sea Basing concept as it applies to surface combatants conducting naval fires by addressing the support requirements for sustained operations.

8.2 LOGISTICS PROCESS

Sustained land attack operations require that the forward-deployed forces receive the proper logistics support. Logistics is defined as the science of planning and carrying out the movement and maintenance of forces.[2] The concept of operations as presented in this document has highlighted the integrated employment of the latest developments in naval systems. The Navy's logistics system must also be capable of providing the required personnel, materiel, and facilities to sustain operations in remote areas of the world.

The Navy's process for providing worldwide logistic support consists of several elements. The process starts in the United States with: (1) the production of the necessary materiel, (2) the training of the necessary personnel, and (3) the planning for and construction of forward based facilities and supply stations. The logistics process ends with the timely delivery of the necessary personnel and materiel to the deployed forces.

8.2.1 Transportation to the Intermediate Support Base (ISB)

Efficient worldwide logistics requires both the transportation and storage of the proper materiel, as well as the availability of the proper personnel to operate and maintain these facilities. Supplies are normally transported to advanced naval bases such as advanced logistics support sites (ALSSs) and forward logistics support sites (FLSSs) by civilian Military Sealift Command

[1] *Naval Transformation Roadmap (Power and Access… From the Sea),* Draft document dated June 2002.

[2] Joint Pub 1-02, *Department of Defense Dictionary of Military and Associated Terms*.

ships or merchant marine ships. Efficient worldwide logistics support depends upon the availability of sufficient sealift/merchant marine forces and the proper planning to assure advanced shipment of the required supplies. The current national military strategy relies on the availability of storage depots and advanced naval bases located on foreign territory.

8.2.2 Transportation to the Surface Combatant

The Navy's combat logistic force ships will be loaded at the advanced naval base with the necessary supplies for the surface combatant forces. Three types of supply ships are expected to be available in the 2015 timeframe: the T-AOE fast combat support ships, the T-AKE auxiliary cargo and ammunition ships, and the T-AO oilers. The T-AOE provides fuel, ammunition, cargo, and water. The T-AKE is a new ship design with the capability to replenish cargo and ammunition. The T-AO provides only fuel to the fleet. The combat logistics force delivers necessary supplies to the designated underway replenishment (UNREP) area for the surface combatants. Typically the UNREP area is relatively close to the area of operations, but still sufficiently remote to be considered safe from enemy attack—normally a one to three hour transit time. Some combat logistics force ships are Navy manned and armed, but most are now operated by the Military Sealift Command with civilian crews and are unarmed.

8.2.3 Surface Combatant Replenishment

The surface combatant replenishment cycle consists of the combatant departing its assigned operational station, transiting to the UNREP area, receiving the supplies, and then returning to its operational station. During replenishment the combatant will receive supplies via either CONREP (refuel or replenish alongside) or vertical replenishment (VERTREP, replenish via helicopter). The amount of time required will depend upon the type of combat logistics force ships involved and the specific supplies needed. Optimally, the combatant will receive all supplies in a single evolution. If multiple replenishment cycles from several ships are required, the time taken will be significantly longer. Under the best of conditions (i.e., daylight and calm seas) the UNREP process is hazardous and time consuming. The process is more difficult under adverse weather conditions. Vertical launched missiles cannot be resupplied at sea. Combatants must return to the advanced naval base to replenish these weapons. The Marine Corps has stated that the underway replenishment of all weapons is required to provide sustained fires.[3]

8.2.4 Surface Combatant Logistics

For this document it is assumed that weapons replenishment is the driving resupply factor for sustainment. Although combatants require fuel, water, food, spare parts, etc. to sustain extended operations, ideally they will receive these supplies during the time required to resupply the weapons. This section focuses on the process of providing the munitions necessary to keep the surface combatants on the firing line. If the simultaneous replenishment of other supplies with munitions is not possible, additional UNREP evolutions will be required and the overall resupply time extended.

8.2.4.1 Weapons

Surface combatants will have two types of weapons in the 2015 timeframe to support land attack operations: vertically launched missiles such as Tomahawk and ALAM, and gun fired munitions such as ERGM and LRLAP. Each type of weapon has its own unique logistics challenges and requirements. Understanding these logistics requirements is critical in developing the broader operational concepts for supporting land attack operations.

[3] *NSFS Requirements for Expeditionary Maneuver Warfare,* CG MCCDC letter, dated 19 Mar 2002.

8.2.4.1.1 Missiles

Vertical launching system (VLS) installations on the cruisers originally included a strikedown crane for at-sea replenishment. However, today's larger and heavier VLS missiles cannot be safely resupplied at sea even under ideal conditions. The strikedown cranes were subsequently removed from the VLS modules and the VLS missiles must now be resupplied pierside.

A single VLS cell can be resupplied in about 20 minutes under good conditions. A single 64-cell launcher would require about 24 hours to be fully resupplied at this rate. Even if only the Tomahawk and ALAMs require resupply, the remaining missiles may still have to be relocated to extend the VLS module's plenum life.[4] VLS resupply will generally require two to three days pierside at the advanced naval base, plus the round-trip transit time of the surface combatant from the operations area. Transit time to the advanced naval base would ideally be about 8 to 12 hours, however it could take much longer. As a result, a surface combatant can be expected to be off the firing line for three to four days minimum whenever a resupply of VLS missiles is required.

8.2.4.1.2 Gun Munitions

Navy gun munitions may be resupplied via CONREP or VERTREP. Combat logistics force ships loaded with the appropriate supplies at the ISB will transit to the designated UNREP area to meet the ships. The T-AOE or T-AKE will conduct munitions replenishment operations in conjunction with the resupply of other goods.

The time required to resupply the ammunition magazine varies with ship class and magazine capacity. The DDG 51 class 5-inch ammunition magazine will take approximately 16 hours to load out with 680 ballistic projectiles and associated propelling charges.[5] This assumes favorable weather conditions and calm seas. The CG 47 class will require 12 to 16 hours for each 600 round magazine, assuming that sufficient manpower and replenishment assets are available to simultaneously resupply both forward and aft magazines. The addition of extended range guided munitions such as ERGM or ANSR[6] to the 5-inch inventory will require a manual magazine reconfiguration to accommodate the specific mix of ammunition provided.[7] These guided munitions will also require additional load cycles because only 16 rounds will fit on a standard pallet vice 48 ballistic rounds.

Effect of Gun Barrel Life on Sustainment

The introduction of higher energy, hotter burning propellant for ERGM will reduce the expected gun barrel life. The threshold wear life of the Mk 45 Mod 4 gun 62-caliber gun barrel for ERGM is 1500 rounds with an objective of 3000 rounds.* The required barrel life for AGS is 3000 threshold and 6000 objective. This is compared with the current 5-inch 54-caliber barrel wear life in excess of 8000 rounds for ballistic ammunition fired with standard NACO propellants.

The 18 surface combatants in the NEA scenario (see section 8.3.1) would fire an average of over 4600 rounds from each gun during the 40-day campaign. Thus, on average every gun barrel would need to be replaced at least once, and in some cases maybe up to three times depending upon the actual wear experienced, assuming all rounds to be equivalent to ERGM or LRLAP in terms of barrel wear. That means all of the ships must return to the ISB at some point in the scenario for regunning. This will further affect the ability to provide sustained naval fires.

* Note: Extended range ammunition that uses a "boost to range" concept such as ANSR can be fired using cooler burning propellants such as NACO and therefore will not adversely affect barrel life.

[4] Each 8-cell VLS module shares a common exhaust gas plenum. Each weapon type has a different affect on the wear of the plenum's ablative resin affecting the module's life.

[5] Based on Fleet Combat Training Center, Atlantic (FCTCLANT) estimates.

[6] The 5" Autonomous Naval Support Round (ANSR) is described in Appendix B.

[7] ERGM and ANSR are significantly longer and heavier than conventional ballistic ammunition, requiring special handling.

Therefore, the resupply times to load these new ammunition types is expected to take at least as long as it currently takes.

The fully automated 155mm ammunition magazines on the new DD(X) ships are expected to require about 13 hours to resupply at sea including 50nm transit time. The magazine for each gun is projected to contain as many as 600 long-range land attack projectiles (LRLAP) and associated propelling charges. The variety of ammunition types should not affect the resupply rate of this automated magazine. Actual resupply times for DD(X) will not be known until the final design and manning level is available.

8.3 VOLUME OF FIRES AND SUSTAINMENT ASSESSMENT

Surface combatants must be capable of providing both NSFS and NSS fires at the right time and of sufficient volume for the entire duration of the operation. These fires must also be fully integrated with other joint and coalition assets. Planning, coordination, communications, and operational strategy are of little value if the required number and mix of weapons are not available. This section examines the capability of the Navy of 2015 to provide the required fires to support a land attack operation.

8.3.1 Scenario

Several analyses and studies were conducted over the past few years based on a North East Asian (NEA) conflict. Results from three of these studies[8] were used to establish a basis for determining the naval fires volume and sustainment requirements during a Major Theater War (MTW). Two of the studies focused on a mid to high intensity scenario over a 17- to 19-hour period. The third study involved a 62-day campaign. The scenarios include the use of naval air, artillery, and NSFS. The types of missions assigned to naval surface fires are based upon the optimal pairing of weapons to targets.[9]

Results from the three studies were combined to establish an average requirement for this operational situation. Estimates of the volume and sustainment capabilities for naval surface fires were determined using both a 10-day assault rate and a 30-day sustained rate of fire. This analysis illustrates the overall projected capabilities of the naval forces involved.

The active Navy had a force level of 316 ships in the year 2000 (table 8-1).[10] Current budgetary and procurement plans suggest that the Navy will have difficulty maintaining a fleet of more than 300 ships through the next decade. Nevertheless, the characteristics of the 2015 carrier strike group (CSG) were projected by assuming that the 316 ship force level will be retained.

Table 8-1. Navy 2000 Force Levels

Ship Type	Number
Aircraft Carriers	12
Surface Combatants	116
Attack Submarines	56
Ballistic Missile Submarines	18
Amphibious Ships	39
Combat Logistics Ships	34
Mine Warfare and Fleet Auxiliaries	41

[8] The three NEA source studies used in the preparation of this document are: *Volume of Fire Study* by NSWC Dahlgren Division, the *NSFS Requirements and Capabilities Study* by JHU-APL (both mid to high intensity scenario runs), and the *Surface Combatant Force Level Study (SCFLS-II)* by NSWC Dahlgren Division (a campaign run). A composite average was developed for use in this document to reflect neither the lowest or highest potential requirement for naval fires.

[9] It is possible to use different weapons delivery assets such as close air support rather than NSFS; however, this would result in suboptimal weapons pairings. Factors impacting optimal weapons pairing include weather, responsiveness, and specific weapons effectiveness.

[10] Congressional Budget Office numbers based on data from the Navy.

Historically, approximately 60% of all ships are available for deployment at any given time (the others being in overhaul, maintenance, or pre-deployment). Therefore, it was assumed that two carrier battle groups would be on station to provide fires for the NEA MTW scenario.

Table 8-2 lists the number of surface combatants projected to form the two CVBGs. Frigates will not have an NSFS or NSS capability and are not included in subsequent analysis.

Table 8-2. Projected Surface Combatants in Two CVBGs in the 2015 Timeframe

Ship Type	Number
Cruisers (CG 52 – NTW BL 2/3)	3
Cruisers (CG 52 – Strike BL 1/4)	2
Destroyers (DDG 51 Block I & II)	5
Destroyers (DDG 81 Block IIa)	6
Destroyers (DD-(X))	2
Frigates (FFG-7)	1
TOTAL	19

Table 8-3 lists the associated combatant logistics support ships assumed available to resupply these two CVBGs.

Table 8-3. Projected Combat Replenishment Ships Supporting Two CVBGs

Ship Type	Number
Fast Combat Support Ships (T-AOE-6)	1
Auxiliary Cargo and Ammunition Ships (T-AKE-1)	2
Fleet Oiler (T-AO-187)	3
TOTAL	6

8.3.2 Surface Combatant and Combat Logistics Force Capacities

Table 8-4 lists the assumed loadouts for the available surface combatants at the start of the scenario. This inventory will be depleted as fires are requested. Individual ships will be removed from supporting land attack missions once all of the relevant weapons are expended, and either assigned to other missions (e.g., theater air defense) or sent to a resupply point (UNREP or ISB). The mix between TLAM and ALAM, and the other vertical launch missiles is assumed to reflect the NSFS/NSS primary mission area for these ships. Gun munition loadout assumes that the ANSR rounds would use the same ERGM stowage ratio[11] relative to the standard ballistic ammunition. The ERGM/ANSR mix used for this analysis was 40/60. The magazine capacities for DD(X) are based on a reduced DD-21 design goal.

[11] Each ERGM requires the same magazine stowage space as 2.3 standard ballistic rounds.

Table 8-4. Projected Ship Weapon Loadout

Ship Type	# in 2 CVBGs	TLAM	SM-2	ALAM	VLA	ESSM	5"/54 Ball.	5"/62 Ball.	ERGM	ANSR	LRLAP
CG 47 – NTW Block 2/3*	3	52	66	0	4	0	389	0	0	267	0
CG 47 – Strike Block 1/4*	2	52	48	18	4	0	156	233	108	160	0
DDG 51 Block I & II	5	38	48	0	4	0	244	0	0	232	0
DDG 51 Block IIa	6	40	36	12	4	4	100	144	92	140	0
DD(X)**	2	39	0	48	0	9	0	0	0	0	600
Total for 2 CVBGs	18	687	750	204	64	42	3299	1330	768	3121	1200

TLAM Tomahawk Land Attack Missiles (Includes TLAM-C/D and TACTOM)
SM-2 Standard Missile (Includes Block III and IV – no contribution to land attack capability)
ALAM Advanced Land Attack Missile (Projected that a new design LAM will IOC in the 2011 timeframe)
VLA Vertical Launch ASROC (no contribution to land attack capability)
ESSM Evolved Sea Sparrow Missile (no contribution to land attack capability)
5"/54 Existing ballistic 5" ammo (range limited to 13nm – little or no contribution to land attack)
5"/62 Extended range Hi-Frag and Cargo rounds compatible Mk 45 Mod 4 guns (range limited to about 21nm – very limited contribution to land attack)
ERGM 5" Extended Range Guided Munitions (compatible with the Mk 45 Mod 4 guns)
ANSR 5" Autonomous Naval Support Round (compatible with both Mk 45 Mod 2 (41+nm) and Mod 4 (55+nm) guns. (Mod 2 guns would need upgrades to add GPS initialization for ANSR rounds and magazines would have to be modified)
LRLAP 155mm Long Range Land Attack Projectile (developed in conjunction with the 155 Advanced Gun System for DD(X). IOC projected in the 2011 timeframe)

* Numbers and configuration for cruiser conversion are to be determined.
** Numbers for DD(X) [96 cell launcher and 600 round 155 magazine] are estimates based on expectations of reducing original DD-21 design goals.

Table 8-5. Combat Logistics Force Ship Capacities

Ship Type	Fuel	Ammunition*	General Cargo	Water
T-AOE	156,000 barrels	1800 tons	650 tons	20,000 gallons
T-AKE	N/A	2390 tons	5460 tons	N/A
T-AO	180,000 barrels	N/A	N/A	N/A

* Note that this includes bombs, missiles, rockets, small arms, etc. for the entire battle group including the two aircraft carriers in addition to 5-inch and 155mm gun ammunition.

Table 8-5 lists the assumed capacities for the combat logistics force ships supporting the NEA MTW scenario.

8.3.3 Weapon Expenditure Rates

The expenditures for the NEA scenario calculated from the three studies are presented in table 8-6. All munitions are expected to be ERGM, ANSR, or LRLAP equivalent. An AGS firing LRLAP at 12 rounds per minute is considered equivalent to one 155mm artillery battery (6 guns) firing at 2 rounds per gun per minute. The average surge and sustained rates used in this document are also listed in the table.

A comparison of tables 8-4 and 8-6 shows that the total of 5,089 ERGM, ANSR, and LRLAP rounds available on the surface combatants will provide fires for less than one day at the assault rate and for 3 to 4 days at the sustained rate. Therefore, in order to sustain fires throughout the scenario, a sufficient inventory and resupply capability is required.

Calculations based upon study data indicate that during the sustained level of support the ground force will generate approximately one NSFS fire

Table 8-6. Ammunition Expenditures for the NEA Scenario

	Volume of Fire Study, NSWCDD	NSFS Req's and Cap. Study, JHU-APL	SCFLS Assessment, NSWCDD	Average
BASIS	5,394 rnds 19 hrs (surge)	18,000 rnds 17 hrs (surge)	302,600 rnds 62 days (campaign)*	
Daily Assault Rate**	2,271	8,470	10,348	7,029
Daily Sustained Rate	499	1,863	2,276	1,546
10-day Assault	22,710	84,700	103,480	70,290
30-day Sustained	14,970	55,890	68,280	46,380
40-day Campaign Totals	37,680	140,590	171,760	116,670

* A 90-day campaign is assumed to consist of 30 days assault rate and 60 days sustained rates where the sustained rate is 22% of the surge rate. The SCFLS 62-day campaign numbers were divided into 20 days at an assault rate and 42 days at a sustained rate using this factor.

**Daily Assault Rate (Surge) is based on an 8-hour high intensity conflict

mission every 20 minutes. During the assault phase, one NSFS fire mission will be generated every 4-1/2 minutes on average. These missions vary in types such as suppression, destruction, interdiction, neutralization, etc., such that on average each mission requires 22 rounds.[12] Since the average fire mission is 22 rounds, then the average rate of fire at the sustained level is about one round every minute, whereas the high intensity (surge) scenario requires about five rounds per minute.

A single Mk 45 Mod 4 gun can fire ERGM or ANSR rounds at a maximum rate of approximately 10 rounds for the first minute. The sustained rate is 2 to 4 rounds per minute and depends upon the magazine crew's ability to manually move rounds from the shipping container to the hoist. The DD(X)'s advanced gun system will provide a sustained firing rate of 12 rounds per minute. Therefore, the scenario's average sustained rate of fire could be met by a DDG with a single gun, but the surge rate would require either a single DD(X), two DDGs with one Mk 45 gun apiece, or one CG with two Mk 45 guns.

8.3.4 Time-on-Station

At the start of the scenario, 9 of the 18 available surface combatants are assumed to be on station and ready to provide fires in support of the land attack missions. The remaining 9 would be assigned other missions until required to replace ships that have depleted their magazine inventories. The 9 surface combatants on station contain 441 land attack missiles and 2,544 long range projectiles. Two or three of the ships would be prioritized to handle as many fire requests as possible while the remaining ships on the firing line would handle the overflow when multiple fire requests are made simultaneously. This ensures that all 9 ships would not require replenishment at the same time.

In this scenario for the sustainment phase, each ship would operate an average of 4+ hours on the firing line before running out of ammunition, assuming no reserve ammunition is retained prior to pulling the ship off the firing line. Rotating all of the 18 ships available to the firing line will sustain operations for approximately 80 hours. If the first ship UNREPs and returns to the firing line before this time, then the requirement for

[12] From the JHU/APL *NSFS Requirements and Capabilities Study*, the average fire mission requires 22 rounds of 155mm LRLAP to achieve desired effects. Therefore it is assumed that the sustained or surge firing rates will be divided into individual engagements each averaging 22 rounds.

naval surface fires could be sustained indefinitely. The previous UNREP analysis indicates approximately 24 hours is required to resupply the gun ammunition and return to the operational area. This would meet the sustainment requirements; however, if the ship is required to return to an advanced naval base to resupply the missiles, then it may exceed the required 80-hour time limit.

The assault phase of the scenario generates a fire request every 4 to 5 minutes. Two or more guns are required to support this rate of fire requests. Therefore, on average one ship must be replaced on the firing line every hour. Since there are only 18 ships available in this scenario and the projected UNREP evolution takes 24 hours, the first ship would not return before the last ship expends its magazine.

Another major limiting factor is the time required for the combat logistics force ships to resupply the surface combatants. There are three ships capable of resupplying gun ammunition at the UNREP area: one T-AOE and two T-AKEs. Each supply ship would handle every third combatant, which would arrive on average about every 13 hours at the sustained rate. If each ship could be reloaded in less than 13 hours, then sustained operations are possible. The DDGs and CGs would require about 16 hours as previously discussed in paragraph 8.2.4.1. Because the surface force consists of 16 DDGs and CGs and only two DD(X)s, additional combat logistics force ships and/or a faster UNREP capability are required. The ammunition replenishment limitation is further exacerbated when supporting assault level operations.

These calculations assume the combat logistics force ships are dedicated to resupplying the surface combatants. However, they also have a requirement to replenish the other ships in the battle groups. Additionally, one of the three supply ships must return to the advanced naval base every 3 or 4 days to reload. The turn around time for a combat logistics force ship (including loadout and transit to and from the advanced naval base) is about a week. Based on this scenario, additional combat logistics force ships are required to support the operation.[13]

8.3.5 Conclusion

The planning, stationing, scheduling, and rotation of mission assignments among surface combatants and supply ships are the key elements in providing and sustaining the required volume of fires needed in the NEA MTW scenario. Minimizing the off station and resupply times will improve the situation. More combat logistics support ships; faster, more automated UNREP resupply systems; and larger surface combatant magazine capacities are necessary to meet the requirement.

> Replenishment at sea is sustainment and must remain the cornerstone of "…anywhere…anytime." But doing business the old way (labor-intensive replenishment at sea) will not suffice on optimally manned ships. Automation, palletization, and modularization not only reduce the Sailor workload, but make replenishment at sea more efficient and less time-consuming. The entire spectrum of replenishment needs to be viewed from a systems approach. We must think of the shipboard magazine as just one component of a complete ammunition supply, storage, and retrieval *system*. Technology and innovation – thinking future, not past – will build towards a rapid and sustainable replenishment at sea capability. If we are to be sustained contributors across the entire spectrum of the battle, we must have the capacity to address Volume Fires needs. Automated replenishment at sea will be an enabler. We should push as much of the logistics and sustainment piece as far forward as possible, maintaining inventory levels sufficient to sustain the fleet in any eventuality.
>
> Rear Admiral Mike Mullen
> Director, Surface Warfare
> 11 September 2000

[13] A more thorough resupply analysis for this two CVBG scenario is necessary to determine the CLF requirement.

9.0 OPERATIONAL OBSERVATIONS

This chapter discusses some of the warfighting capabilities developed and executed during recent engagements. Transformation is not always about new systems, but can also include connecting and using old systems in new ways to provide the flexibility required to counter new and unanticipated threats. The surface combatant must bring a full array of capability that is interoperable in the joint warfighting arena. Concepts and systems discussed, if implemented, in previous chapters will provide the surface combatant of the future with these capabilities.

Recent military experiences from Operation Enduring Freedom in Afghanistan have validated many of the concepts of joint network centric warfare in general, and the land attack operational concepts contained within this document in particular.[1] Numerous platforms and assets were connected in novel ways, providing new or enhanced operational capabilities to counter the latest threats.

Afghanistan is a landlocked country and surface combatants were not directly involved beyond the initial Tomahawk strikes. It is instructive, however, to understand the evolving characteristics of 21st Century warfare in general, and the rapidly changing land attack capabilities of the other naval and joint forces in particular. The surface combatants will be significant players in the future as they are equipped with the enhanced land attack warfare systems as addressed in this document. As a primary example, targeting information is being provided directly from the sensor to the shooter, and the shooter must be capable of processing this information and rapidly putting ordnance on target.

After action reports from Operation Enduring Freedom have also highlighted many of the issues raised in prior chapters of this document. Some of these issues are over-the-horizon communications, volume of fire versus precision, integration of intelligence, surveillance, and reconnaissance (ISR) assets, replenishment at sea, and a common operational picture.

Some relevant insights into the evolving characteristics of 21st Century warfare are summarized in the following paragraphs.

9.1 NETWORK CENTRIC WARFARE

Operation Enduring Freedom demonstrated the effectiveness of network centric warfare, and the emergence of the first generation of joint sensor, command and control, and engagement grids. The U.S. was able to monitor the battlefield over extended time periods by using a combination of manned and unmanned aircraft. These sensors provided a continuous flow of information to air and ground targeting systems. Directly linking these targeting systems to the global positioning system (GPS) guided weapons resulted in a significant compression of the sensor-to-shooter targeting cycle and an increase in the precision strike accuracy. A loitering aircraft carrying precision-guided munitions could receive GPS coordinates directly from the ground observers and provide ordnance-on-target within 10 minutes in some cases.

9.1.1 Sensor Grid

The networking and integration of data from the various ISR assets in the theater of operations

[1] Information contained in this chapter was derived from various open source materials.

provided a significant improvement in on-scene, near real-time and persistent situational awareness over the battlefield. The significant new contributors to the ISR asset pool were the Navy's P-3C Orion maritime patrol aircraft and the unmanned aerial vehicles (UAVs). These new assets, when combined with existing photographic and intelligence satellites, the E-3 airborne warning and control system (AWACS), the joint surveillance target attack radar system (JSTARS), and other electronic surveillance and intelligence gathering tactical aircraft, provided the prototype integrated sensor grid that resulted in enhanced mission effectiveness for the U.S. forces in Afghanistan.

A second major achievement was the ability to rapidly transfer data from the intelligence communities' assets and unique systems to the operational planners and weapon delivery platforms. Significant technical and procedural barriers continue to exist between these systems. However Operation Enduring Freedom exemplifies the movement toward a nearly seamless network centric battlefield.

9.1.1.1 P-3C Maritime Patrol Aircraft

The P-3C is the Navy's land-based maritime patrol aircraft designed in the 1950s to search for Soviet submarines. The recent addition of a precision surveillance capability enabled the P-3C to gather intelligence, maintain long-term surveillance, and conduct reconnaissance of suspicious targets in the mountainous terrain of a landlocked country. This aircraft also has the capability to fire the stand-off land attack missile (SLAM), act as a communication relay platform, and perform battle damage assessment. The P-3C's principle value, however, was providing situational awareness over terrain where deep valleys and towering mountains limited visibility. A verbal or electronic message could be sent out as soon as a suspected target was detected. For example, during Operation Anaconda in March 2002, the P-3Cs carried Navy SEAL commandos who radioed descriptions of the enemy to fellow special operations troops fighting on the ground. Images from the electro-optical, infrared, and synthetic aperture radar sensors were also sent directly to (1) ground units via the tactical common data link (TCDL), and (2) senior commanders after routing via satellite communications through the regional operations centers. A megabyte-size jpeg image could be sent in 5–6 minutes. Studies are underway to add a broadband link capability for broadcasting real-time streaming video of time critical targets.

9.1.1.2 Unmanned Aerial Vehicles (UAV)

The Air Force's Predator was the UAV that had the greatest impact on the prosecution of the war. This UAV played a key role in sharply compressing the time delay between target identification and weapons release from hours to minutes or less. Operators at a ground tactical control station (TCS) provide remote control of the Predator's airframe and sensors. A satellite link handles communications between the aircraft, ground operators, and anyone receiving the live video imagery. In the ISR mode, Predator is most effective when cued by other intelligence sources and used to provide real-time intelligence on targets that already have been identified. In the target attack mode, Predator realized a major improvement in capability when it was upgraded to provide live video feeds directly to the AC-130 gun ships. These gun ships used the live video to identify targets while en route to the target area, and could immediately fire at the targets once reaching the area. Predator also can illuminate targets by laser designation for attack by precision weapons fired from remote distances and, on occasion, has even carried and fired its own Hellfire missiles at selected targets. Future improvements call for Predator video to be provided to the cockpits of all Air Force and Navy attack aircraft. Mission planners also want the capability to rapidly integrate all intelligence data, whether from a Predator or other sources, into a single common tactical picture.

The RQ-4A Global Hawk is a long range, high altitude UAV that had its operational debut over Afghanistan. Global Hawk provides broad area surveillance while flying at elevations at or above 60,000 feet, has a range of 1200 miles, can loiter for 24 hours, and carries high resolution radar sensors that can capture images through clouds and darkness. Follow-on versions may collect signals intelligence as well as imagery. In the ISR mode, Global Hawk works in conjunction with the Predator and other intelligence systems to gather a persistent layered picture of the battlefield.

Both the Navy and Marine Corps have completed a major overhaul of their UAVs plans and are preparing to start several new programs. All UAVs will be controlled by the TCS. The Navy intends to pursue three types of UAVs: (1) a long duration, standoff ISR vehicle (possibly a marinized version of the Global Hawk); (2) a penetrating surveillance and strike UAV; and (3) a tactical UAV. However, there is no funded program to provide a UAV capability to surface combatants. The USMC will also seek a tiered approach, focusing on systems that are fully autonomous, TCS compliant, require minimum training and logistics, and are affordable.

9.1.1.3 Targeting

Extensive use of GPS was the most notable targeting improvement. GPS enabled precision strikes from information provided by both operational command centers using near real-time sensor information, and by special operations forces on the ground which directly uplinked real-time precision coordinates to bomber and attack aircraft. The use of GPS coordinates also enabled aircraft to deliver weapons from relatively large standoff distances to either ensure safety or surprise.

The ability of U.S. and British special operations forces (SOF), acting as forward observers, to call in air strikes also provided a significant tactical advantage and immeasurably contributed to the successful and accelerated prosecution of the war. This is an excellent example of the advantages provided by network centric warfare when the decision authority is moved down the chain of command to the personnel in the field. This capability was enabled by providing the SOFs with: (1) the tactical authority to identify targets and to immediately call in air strikes, and (2) the capability to provide near real-time precision targeting information to loitering attack aircraft carrying precision guided weapons that could be programmed by the aircraft just before weapon launch. This capability was so successful that 84% of the Navy's attack aircraft did not know the specific targets they were to attack until after they were in the target area.

9.1.2 Command and Control (C2) Grid

The primary command-and-control communications network used today by all services to create an air picture is the joint tactical information distribution system (JTIDS), also known as Link 16. JTIDS primary purpose is to pass targeting data to attack aircraft from airborne and ground sensors. JTIDS also allows numerous sensors and elements to share information sufficiently to provide a common air picture over the battlefield known as the single integrated air picture (SIAP). The joint composite tracking network (JCTN) is also being developed to track and engage potential targets. The Navy's cooperative engagement capability (CEC) system that consolidates multiple sensor data into single composite track provides a major element of the JCTN capability to Navy units.

Military actions in Afghanistan highlighted the recurring problem of communicating with mobile ground units. Also identified as an issue is the increasing demand for bandwidth to support many of the new systems coming on line. Some digital communications systems were found to not always be interoperable. This mountainous terrain made it difficult for troops who tried to

use line-of-sight communications, forcing them to use expensive military and commercial satellites instead.

Despite the problems noted above, communications links were responsible for providing unprecedented connectivity between a vast array of sensors, shooters, and decision makers. The Navy and Air Force also employed satellite uplinks and downlinks to establish communications between forces on the ground and air assets overhead. These links provided the sensor video feeds that were relayed as targeting information to the shooters.

9.1.3 Engagement Grid

Precision-guided weapons, together with the ability to either laser designate the target or rapidly provide GPS coordinates for the target, greatly contributed to overall mission effectiveness. Precision-guided munitions accounted for more than 60% of the ordnance expended in Afghanistan. The most notable weapon was the air-delivered precision guided 2,000 pound joint direct attack munition (JDAM), which has a circular error probable of under 30 feet. JDAM can be delivered by the Air Force's long-range bombers, as well as by Air Force and Navy tactical aircraft. JDAM will soon be supplemented by a 500-pound version that will reduce collateral damage.

The next generation precision-guided munition, providing a launch-and-leave capability, was successfully tested in December 2001 at the China Lake test facility. The AGM-154C unitary warhead variant of the joint standoff weapon (JSOW-C) was launched at 20,000 feet, flew autonomously with the aid of GPS navigation for approximately 20 nautical miles, located the target using an imaging infrared seeker, and hit the desired aimpoint. The JSOW-C also will be the first U.S. weapon to incorporate the broach-penetration multiple warhead, developed by BAE Systems.

A new thermobaric bomb was also quickly designed and first used in combat on a tunnel at the start of Operation Anaconda in March 2002. This weapon was specifically developed to counter the enemy's use of the vast cave complexes in the Afghanistan mountains as a sanctuary. The bomb releases and then detonates a fine cloud of highly explosive chemicals, creating a massive shock wave that destroys everything inside a cave, bunker, or building.

Precision-guided munitions, however, are not always the best choice for area targets such as extended and fortified trench lines protecting cities and strongholds. Vietnam style carpet-bombing using "dumb" bombs once again proved highly effective against these target types. There is no substitute for sustained volume of fire (i.e., a large number of bombs covering a large target area) for degrading the enemy's ability to fight.

The emerging land attack capabilities of the surface combatant will enhance the variety of "arrows in the quiver" of the warfighter. This will also allow more appropriate weapon to target pairing than is presently available in many situations.

9.2 JOINT OPERATIONS

The 1991 Gulf War proved that a lot of work was still required before the U.S. Army, Navy, Air Force, and Marine Corps forces, as well as coalition forces, were truly interoperable. Major efforts in establishing joint organizations, communications, doctrine, procedures, and training since that time have proved highly effective. In Afghanistan joint interoperability allowed all the commanders in the region, as well as the Pentagon, to see the common operational picture on their desktop computers. All of the communications and most of the weapons were common, as well as the tactics, techniques and procedures for engaging targets. Forward ground observers calling in strikes saw almost no difference between Navy, Marine Corps, Air Force, or Coalition aircraft.

Unlike Desert Storm and Allied Force, several nearby nations with modern airports refused access to U.S. military forces for Operation Enduring Freedom. This decision severely limited the U.S. Air Force's ability to stage tactical air strikes from land bases relatively close to the battlefield. Common systems and joint training enabled this missing component to be replaced with sea-based forces, and throughout the military campaign the Naval forces provided critical capabilities to support joint and combined operations. U.S. surface combatants and U.S. and Royal Navy submarines started the retaliatory action on 7 October 2001 with the launch of more than 70 Tomahawk cruise missiles against targets in Afghanistan. Navy and Marine Corps attack and support aircraft, teamed with long-range Air Force B-2 bombers (flying from the U.S.) and B-1 and B-52 bombers (flying from Diego Garcia in the Indian Ocean), next mounted an around-the-clock air campaign directed by Army General Tommy Franks, commander in chief of the U.S. Central Command. Navy and Marine Corps aircraft were refueled in flight several times during their 6–10 hour missions by a fleet of U.S. and Royal Air Force aerial tankers.

Command and control of air operations has also been a major challenge within the joint and coalition forces, right up through the 1999 Kosovo campaign. In Afghanistan, the combined forces air component commander (CFACC) provided a high degree of joint interoperability and coalition integration to optimize the use all available air assets.

9.3 TRANSFORMATIONAL CAPABILITIES

The battle underway in Afghanistan, the opening conflict of the 21st century, is an early illustration of the far-reaching transformation sweeping the joint military forces. Transformation is not always about new systems, but can also include connecting and using old systems in new ways to provide the flexibility required to counter new and unanticipated threats. The best symbol of this new mix of the modern and the mundane may be the lumbering 50-year-old B-52 strategic bomber, once considered a relic of the cold war, providing 35 tons of volume fire and close air support to troops on horseback. In this case some of these troops were special operations forces (SOFs) equipped with satellite phones and GPS devices capable of providing real-time precision targeting information to the bombers. Combining the B-52s (along with tactical aircraft) with the SOFs produced dramatic results as the Afghan Northern Alliance, outnumbered two-to-one by a dedicated and well-resourced foe, was able to overrun the entire country within weeks.

The naval forces provided additional examples of transformational capabilities. By early January 2002 the naval services had flown 75% of the strike sorties carried out over Afghanistan from carriers operating more than 400 miles away. The quality of the strikes also improved as well. During Desert Storm the Navy averaged 10 aircraft per target. In Afghanistan one aircraft could take out two targets. The Marine Corps also showed the potential for ship-to-objective maneuver by flying more than 400 miles inland to an expeditionary site south of Kandahar, quickly seizing the Kandahar airfield needed for future operations, and conducting mobile hunter-killer patrols (similar to those practiced during the Hunter Warrior experiments in 1997) to block enemy escape routes. In addition, the aircraft carrier USS Kitty Hawk deployed with a minimal air wing to serve as a floating special operations base in the North Arabian Sea.

The growing capability of the fleet's Tomahawk cruise missile, originally developed as part of the nuclear arsenal, is also indicative of the Navy's steady transformation. The Tomahawk has transformed cruisers and destroyers from principally defensive escorts into critical components of long-range strike, and eventually will support

time critical strike and requests for fire support. The Tomahawk targeting cycle was three days during Desert Storm in 1991. In the 1999 operations in Kosovo (allied force), the targeting cycle was reduced to about 100 minutes. For Enduring Freedom, it was reduced to about 30 minutes in some cases. The introduction of the Tactical Tomahawk weapon control system in 2004 will allow onboard mission planning and execution, and near real-time targeting and retargeting when the missile is in flight.

9.4 CONCLUSIONS

9.4.1 Special Circumstances

The significance of the lessons learned from the current conflict must be carefully considered in light of the special circumstances involved. Although the current success in Afghanistan has been dramatic, the success has depended on three primary factors.

First, as the French learned during the German blitzkrieg in the opening days of World War II, war cannot be reduced to forward observers and artillery. This tactic worked well in Afghanistan because the spotters had the support of the local population and could travel easily. This will not be possible if the local population is hostile.

Second, complete air superiority was established very early in the theater of operations. This freedom provided the airborne surveillance assets, special operations forces, attack aircraft, and heavy bombers with the ability to operate together unimpeded and achieve maximum effectiveness. Complete air superiority may not be available in future conflicts against a country with a sophisticated air defense capability. Serbian air defense forces were well trained, resilient, highly mobile, concealed, and patient, and provided a sustained (although degraded) capability throughout the 78-day campaign.

Third, climate did not significantly impact the campaign. In Kosovo nearly 70% of the battlefield was covered 50% of the time with low clouds and fog. This rendered electro-optical and infrared sensors and human eyeballs useless in detecting and identifying most targets. Forested mountainous terrain had an equally adverse effect on all-weather radar. Precision strikes are only as good as the ISR systems that provide the targeting information. Over the past ten years, the quantity and capability of the precision strike weapons has outpaced the capability of the supporting ISR structure. Target concealment, deception, and mobility as well as weather, terrain, and air defenses will make the ISR problem even more difficult.

9.4.2 Land Based Versus Sea Based Aircraft

The Afghanistan campaign has convincingly demonstrated that the long-running debate of the effectiveness of land-based bombers versus sea-based aircraft has no place in the 21st century joint operations. The air campaign was remarkable for the degree of seamless interoperability and mutual support between the Air Force and Navy-Marine Corps team's aviation assets. Because of their larger payloads, the Air Force's B-1, B-2, and B-52 long-range bombers carried most of the munitions into the theater of operations, and Air Force's tanker, surveillance, and transport aircraft were also key to operational effectiveness. U.S. Navy and Marine Corps' F/A-18s, F-14s, and AV-8B Harriers flew most of the strike sorties, however, providing a round-the-clock strike capability and escorts for other U.S. and coalition aircraft. The Navy's EA-6Bs, E-2Cs, S-3s, and P-3Cs provided critical support to the overall campaign as well.

The long ranges involved in all air support missions put a large strain on both the aircraft and aircrews as well the supporting aircraft, such as the air tankers. This was true for both land and sea based aircraft.

9.4.3 Joint Flexibility

Future conflicts will require strategic, operational, and tactical flexibility and synergy between the joint military services to achieve national objectives. This flexibility will enable each service to leverage its unique synergies on the unpredictable modern battlefield. No single weapon system is sufficient in and of itself. The warfighter must be provided with a variety of weapon delivery systems, coupled with a high quality ISR capability, to ensure success on nearly every future battlefield. A good example of this flexibility is the blurring of the traditional line between the intelligence community and the tactical operators as the connectivity of the systems is improved. In Afghanistan this flexibility resulted in the rapid fusion of data received from the various ISR assets into tactically useful information, and the rapid passing of these intelligence products to mission planners and even weapon delivery platforms to rapidly engage targets.

The new challenge will be contending with uncertainty. Planners cannot design specific forces for specific scenarios because they can no longer predict circumstances and adversaries with any precision. No one was pondering a major campaign in Afghanistan on 10 September 2001. The U.S. requires strategically agile forces that offer a broad range of capabilities while avoiding fixed airfields, forward bases, and ports that the enemy can strike back at. This force includes long-range airpower, highly maneuverable ground forces, and forward presence with a full spectrum naval fires capability.

9.4.4 Surface Combatant Contributions

Forward presence has little point unless the ships represent significant striking power. The Aegis combatants will provide a moderate land attack capability with the existing and programmed gun and missile systems. However, these same platforms can provide a transformational land attack capability by digitally connecting the existing sensor, command and control, mission planning, and engagement components. This connectivity would provide a true network centric warfare capability against time critical targets as well as provide a sustained and distributed fire support capability to support the maneuvering forces on the ground. Once these systems are fully netted, surface combatants will have the capability to conduct early, responsive, and precision tactical, operational, and strategic land attack missions while supporting the arrival of follow-on naval, joint, and coalition forces.

The new land attack capability of the surface combatants will provide additional options for engaging enemy targets. Many targets may also be more optimally engaged with munitions such as ERGM or LRLAP vice some air delivered ordnance. This means that the target is appropriately engaged but with a cheaper yet similarly effective munition. These costs include the overall wear on the aircraft and support systems as well as the risk to the aircrew. Additionally, sea based fires may be more responsive to engaging a time sensitive target since they are available during day and night as well as during periods of reduced visibility.

Afghanistan is unique because it is a land-locked country and Tomahawk is the only surface combatant weapon with sufficient range to reach potential targets. Future conflicts may find a large percentage of targets within range of all of the surface combatant's land attack weapons, and may pose a sophisticated air threat. In this case, a long-range and robust land attack capability from both gun and missile systems would be highly valuable.

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APPENDIX A—ACRONYMS/GLOSSARY

Part 1. Acronyms

AAAV	advanced amphibious assault vehicle
AADC	area air defense commander
AAN	Army After Next
AAW	anti-air warfare
AAWC	anti-air warfare commander
ABCS	army battle command system
ACA	airspace control authority
ACA	airspace coordination area
ACE	analysis and control element
ACM	aviation control measure
ACTD	advanced concept technology demonstration
ADNS	automated digital network system
AEF	aerospace expeditionary force
AEW	aerospace expeditionary wing
AFATDS	advanced field artillery tactical data system
AGM	attack guidance matrix
AGS	advanced gun system
ALAM	advanced land attack missile
ALIS	Aegis LAN interconnect system
ALOR	artillery launched observer round
ALSS	advanced logistics support site
AMDPCS	air-missile defense planning and control system
ATF	amphibious task force
ANGLICO	air and naval gunfire liaison companies
ANSR	autonomous naval support round
AO	area of operation
AOA	amphibious objective area
AOC	air operations center
APS	afloat planning system
AREC	air resources element coordinator
ARFOR	Army forces
ARG	amphibious ready group
ARL	airborne reconnaissance low
ARL-C	airborne reconnaissance low communications intelligence configuration
ARL-M	airborne reconnaissance low-multifunction
ASAS	all source analysis system
ASUWC	anti-surface warfare commander
ASWC	antisubmarine warfare commander
ATACMS	Army tactical missile system
ATD	advanced technology demonstration
ATO	air tasking order
ATWCS	advanced Tomahawk weapons control system

AWACS	airborne warning and control system
AWE	advanced warfighting experiment
BCD	battlefield coordination detachment
BDA	battle damage assessment
BFACS	battlefield functional area C2 systems
BLT	battalion landing team
C2	command and control
C2W	command and control warfare
C3I	command, control, computer, and intelligence
C4ISRT	command, control, communications, computers, intelligence, surveillance, reconnaissance, and targeting
CADRT	computer aided dead reckoning tracer
CATF	commander, amphibious task force
CBRNE	chemical, biological, radiological, nuclear, or explosive
CCS	common operational picture correlation site
CE	command element
CEC	cooperative engagement capability
CEP	circular error probable
CFACC	combined forces air component commander
CFL	coordinated fire line
CG	controlling unit
CGS	common ground station
CIC	combat information center
CINC	commander in chief
CINC	combatant commander; commander in chief; commander of a combatant command
CJTF	commander joint task force
CMATD	competent munition advanced technology demonstration
CMSA	cruise missile support activity
COC	combat operations center
COMINT	communications intelligence
CONOPS	concept of operations
COP	common operational picture
COTS	commercial off-the-shelf
CP	command post
CRD	Capstone Requirements Document
CSAR	combat search and rescue
CSG	carrier strike group
CSSCS	combat service support control system
CTD	common tactical data set
CTP	common tactical picture
CTAPS	contingency theater automated planning system
CVIC	carrier intelligence center
CWC	composite warfare commander

D3A	decide, detect, deliver, and assess
DACT	digital automated communications terminal
DARPA	Defense Advanced Research Projects Agency
DCGS	distributed common ground system
DCT	digital communications terminal
DII COE	defense information infrastructure common operating environment
DIWS	digital imagery workstation suite
DMD	digital message device
DMR	digital modular radio
DOCC	deep operations coordination cell
DOTES	doctrine, organization, training, equipment, or support
DS	direct support
DSABL	depth and simultaneous attack battle laboratory
DSMAC	digital scene mapping and correlation
DSTWN	direct sensor to weapon network
DTD	data transport devices
DTO	defense technology objective
ECC	effects coordination cell
ECOC	Enhanced Combat Operations Center
ECOORD	effects coordinator
ECT	effects control team
EHF	extremely high frequency
ELB	Extending the Littoral Battlespace
EMC	electromagnetic compatibility
EOM	end of mission
EPLRS	enhanced position location reporting system
EOSS	electro-optical sight system
ERGM	extended range guided munition
ESF	expeditionary strike force
ESG	expeditionary strike group
ESSM	Evolved Sea Sparrow Missile
ET	electronic time
EW	electronic warfare
FA CP	field artillery command posts
FAC	forward air controller
FASM	forward air support munition
FBCB2	Force XXI battle command for brigade and below
FBE	fleet battle experiments
FDC	fire direction centers
FECC	fires and effects coordination cell
FFA	free fire area
FFCC	force fires coordination center
FIOP	family of interoperable operational pictures
FIST	fire support team

FLSS	forward logistics support site
FO	forward observer
FoS	family of systems
FPF	final protective fire
FPPWP	first preplanned waypoint
FR	fire request
FSA	fire support area
FSC	fire support coordinator
FSCC	fire support coordination center
FSCL	fire support coordination line
FSCM	fire support coordination measure
FSCOORD	fire support coordinator
FSE	fire support element
FSO	fire support officer
FSS	fire support station
FTI	fixed target indicator
GBS	global broadcast system
GCCS-A	global command and control system–Army
GCCS-M	global command and control system–maritime
GCS	gun computer system
GENSER	general service
GN&C	guidance, navigation, and control
GPS	global positioning system
GS	general support
GS-R	general support-reinforcing
GTL	gun-target line
GUI	graphical user interface
GWS	gun weapon system
HAE	high altitude endurance
HF	high frequency
HHQ	higher headquarters
HIDACZ	high-density air control zone
HI-FRAG	high-fragmentation
HMMWV	high mobility multipurpose wheeled vehicle
HPTL	high payoff target list
HSI	human systems integration
ICM	improved conventional munition
IFF	identification friend or foe
IMINT	imagery intelligence
IQVC	independent quality verification checks
ISR	intelligence, surveillance, and reconnaissance
ISRT	intelligence, surveillance, reconnaissance, and targeting
IUC	independent user centers

JAOC	joint air operations center
JCTN	joint composite tracking network
JDAM	joint direct attack munition
JDN	joint data network
JEFX 02	Joint Expeditionary Force Experiment 2002
JFACC	joint force air component commander
JFC	joint force commander
JFE	joint fires element
JFMCC	joint force maritime component commander
JITPL	joint integrated target priority list
JMEM	joint munitions effectiveness manual
JOA	joint operations area
JOPES	joint operational planning and execution system
JPN	joint planning network
JSEAD	joint suppression of enemy air defenses
JSIPS	joint service imagery processing system
JSTARS	joint surveillance target attack radar system
JTF	joint task force
JTFC	joint task force commander
JTIDS	joint tactical information distribution system
JTRS	joint tactical radio system
JVMF	joint variable message format
LAC	launch area coordinator
LAN	local area network
LAS	land attack system
LASM	land attack standard missile
LAW	land attack warfare
LAWC	land attack warfare commander
LAWREC	land attack warfare resources element coordinator
LCU	lightweight computer unit
LDM	laser designation module
LF	landing force
LFOC	landing force operations center
LLDR	lightweight laser designator
LOS	line-of-sight
LRIP	low-rate initial production
LRLAP	long-range land attack projectile
LSS	littoral surveillance system
MAE	medium altitude endurance
MAGTF	Marine air ground task forces
MARFORLANT/PAC	Marine Forces Atlantic and Pacific
MBC	Maritime Battle Center
MCCDC	Marine Corps Combat Development Command

MCS	maneuver control system
MCWL	Marine Corps Warfighting Laboratory
MDD	maritime defense demonstration
MDS	mission distribution system
MDU	mission data updates
MEB	Marine expeditionary brigade
MEMS	micro electro-mechanical sensor
METOC	meteorology and oceanography
MEU	Marine expeditionary unit
MFR	mission fired report
MLE	Marine liaison element
MML	master mission library
MNS	mission needs statement
MRLAP	medium range land attack projectile
MRSI	multiple-rounds-simultaneous-impact
MTI	moving target indicator
MTO	message to observer
MTW	major theater w
NALE	naval and amphibious liaison element
NATO	North Atlantic Treaty Organization
NAVSSI	navigation sensor system interface
NCA	national command authority
NCC	naval component commander
NCD	naval coordination detachment
NCW	network-centric warfare
NEA	North East Asian
NEO	non-combatant evacuation operation
NESP	Navy EHF SATCOM
NFA	no-fire area
NFC	naval fires cell
NFCC	naval fires coordination cell
NFCS	naval fires control system
NFN	naval fires network
NGFS	naval gun fire support
NGLO	naval gunfire liaison officer
NIS	national input segment
NLT	no-later-than
nm	nautical mile
NRTPC	near real-time procedural coordination
NSFS	naval surface fire support
NSS	naval surface strike
NWDC	Navy Warfare Development Command
OMFTS	*Operational Maneuver From the Sea*
OPCON	operational control

OPFAC	operational facilities
ORD	operational requirements document
OSD	operational sequence diagram
OTC	officer in tactical command
OTF	order to fire
OTH	over-the-horizon
PLGR	precision lightweight GPS receiver
POL	petroleum/oil/lubricant
PPS	precise positioning service
PTW	precision targeting workstation
R	reinforcing
RCS	radar cross section
RFA	restrictive fire area
RFL	restrictive fire line
RHC	rugged hand-held computer
ROE	rules of engagement
ROM	read-only-memory
RTO	radio-telephone operator
RTS	real time subsystem
RW CAS	rotary-wing close air support
S&TA	surveillance and target acquisition
SAC	supporting arms coordinator
SACC	supporting arms coordination center
SADARM	sense and destroy armor
SAG	surface action groups
SAR	synthetic aperture radar
SAT	submarine advisory team
SATCOM	satellite communication
SCDL	surveillance control data link
SCIF	special compartmented information facility
SEAD	suppression of enemy air defenses
SEC	submarine element coordinator
SEWC	space and electronic warfare commander
SFCP	shore fire control party
SHF	super high frequency
SI	special intelligence
SIAP	single integrated air picture
SINCGARS	single channel ground and airborne radio system
SIPRNET	Secret internet protocol router network
SIS	SCI isolation segment
SLAM	stand-off land attack missile
SMART-T	secure mobile anti-jam reliable tactical terminal
SOF	special operations forces

SORTS	status of resources and training system
STOM	*Ship-To-Objective Maneuver*
STWC	strike warfare commander
SUW	surface warfare
T+N	merger of Tactical Tomahawk weapons control system (**T**TWCS) and naval fires control system (**N**FCS)
TA	target acquisition
TACC	tactical air control/command center
TACON	tactical control
TACP	tactical air control party
TACTOM	Tactical Tomahawk
TADIL	tactical digital information links
TAIS	tactical airspace information system
TBM	tactical ballistic missiles
TBMCS	theater battle management core system
TBM TEL	Tactical ballistic missile transporter-erector launcher
TCDL	tactical common data link
TCI	Tomahawk command information
TCOMMS	Tomahawk communications system
TCS	tactical control station
TCT	time critical target(ing)
TDDS	tactical receive equipment (**T**RE) data distribution system
TDO	TCI distribution order
TEA	Tomahawk executive agent
TEL	transporter-erector-launcher
TERCOM	terrain contour mapping
THS	target hand-off system
TIBS	tactical information broadcast system
TLAM	Tomahawk land attack missile
TLDHS	target location designation and handoff system
TLE	target location error
TLM	target location module
TMPC	Theater Mission Planning Center
TPS	Tomahawk planning system
TRADOC	US Army Training and Doctrine Command
TRD	training requirements document
TRE	tactical receive equipment
TSC	TLAM strike coordinator
TSN	Tomahawk strike network
TSS	target selection standards
TST	time sensitive target(ing)
TTDBM	Tactical Tomahawk data base manager
TTP	tactics, techniques, and procedures
TTWCS	Tactical Tomahawk weapons control system
TUAV	tactical unmanned aerial vehicles

TWCS	Tomahawk weapon control system
UAV	unmanned aerial vehicle
UHF	ultra high frequency
UNREP	underway replenishment
URN	unique reference number
USMTF	United States Message Text Format
VERTREP	vertical replenishment
VHF	very high frequency
VLA	vertical launch anti-submarine
VLS	vertical launch(ing) system
VTUAV	vertical takeoff unmanned aerial vehicles
WIPT	working integrated product team
ZF	zone of fire

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Part 2. Glossary

air tasking order — A method used to task and disseminate to components, subordinate units, and command and control agencies projected sorties/capabilities/forces to targets and specific missions. Normally provides specific instructions to include call signs, targets, controlling agencies, etc., as well as general instructions. Also called ATO. (Joint Pub 1-02)

amphibious objective area — A geographical area, delineated in the initiating directive, for purposes of command and control within which is located the objective(s) to be secured by the amphibious task force. This area must be of sufficient size to ensure accomplishment of the amphibious task force's mission and must provide sufficient area for conducting necessary sea, air, and land operations. (Joint Pub 1-02)

amphibious task force — The task organization formed for the purpose of conducting an amphibious operation. The amphibious task force always includes Navy forces and a landing force, with their organic aviation, and may include Military Sealift Command-provided ships and Air Force forces when appropriate. Also called ATF. (Joint Pub 1-02)

area target — A target consisting of an area rather than a single point. (Joint Pub 1-02)

barrage fire — Fire which is designed to fill a volume of space or area rather than aimed specifically at a given target. (Joint Pub 1-02)

battle damage assessment — The timely and accurate estimate of damage resulting from the application of military force, either lethal or non-lethal, against a predetermined objective. Battle damage assessment can be applied to the employment of all types of weapon systems (air, ground, naval, and special forces weapon systems) throughout the range of military operations. Battle damage assessment is primarily an intelligence responsibility with required inputs and coordination from the operators. Battle damage assessment is composed of physical damage assessment, functional damage assessment, and target system assessment. Also called BDA. (Joint Pub 1-02)

battle damage indications (BDI) BDI is the immediate indications and evidence from sensor systems or observers of the level of damage to and the post-damage state of the target. BDI provides information for an intelligence estimate (or BDA) of the target.

battlefield coordination detachment An Army liaison provided by the Army component commander to the Air Operations Center (AOC) and/or to the component designated by the joint force commander to plan, coordinate, and deconflict air operations. The battlefield coordination detachment processes Army requests for tactical air support, monitors and interprets the land battle situation for the AOC, and provides the necessary interface for exchange of current intelligence and operational data. Also called BCD. (Joint Pub 1-02)

boundary A line that delineates surface areas for the purpose of facilitating coordination and deconfliction of operations between adjacent units, formations, or areas. (Joint Pub 1-02)

circular error probable An indicator of the delivery accuracy of a weapon system, used as a factor in determining probable damage to a target. It is the radius of a circle within which half of a missile's projectiles are expected to fall. Also called CEP. (Joint Pub 1-02)

close support That action of the supporting force against targets or objectives which are sufficiently near the supported force as to require detailed integration or coordination of the supporting action with the fire, movement, or other actions of the supporting force. (Joint Pub 1-02)

combat assessment The determination of the overall effectiveness of force employment during military operations. Combat assessment is composed of three major components: (a) battle damage assessment; (b) munitions effects assessment; and (c) reattack recommendation. The objective combat assessment is to identify recommendations for the course of military operations. The J-3 (operations directorate) is normally the single point of contact for combat assessment at the joint force level, assisted by the joint force J-2 (intelligence directorate). Also called CA (Joint Pub 1-02)

combat information center The agency in a ship or aircraft manned and equipped to collect, display, evaluate, and disseminate tactical information for the use of the embarked flag officer, commanding officer, and certain control agencies. Certain control, assistance, and coordination functions may be delegated by command to the combat information center. Also called action information center; CIC. (Joint Pub 1-02)

command and control warfare The integrated use of operations security, military deception, psychological operations, electronic warfare, and physical destruction, mutually supported by intelligence, to deny information to, influence, degrade, or destroy adversary command and control capabilities, while protecting friendly command and control capabilities against such actions. Command and control warfare is an application of information warfare in military operations and is a subset of information warfare. Command and control warfare applies across the range of military operations and all levels of conflict. Also called C2W. C2W is both offensive and defensive: a. C2-attack. Prevent effective C2 of adversary forces by denying information to, influencing, degrading, or destroying the adversary C2 system. b. C2-protect. Maintain effective command and control of own forces by turning to friendly advantage or negating adversary efforts to deny information to, influence, degrade, or destroy the friendly C2 system. (Joint Pub 1-02)

coordinated fire line The coordinated fire line (CFL) is a line beyond which conventional, indirect, surface fire support means may fire at any time within the boundaries of the establishing headquarters without additional coordination. The purpose of the CFL is to expedite the surface-to-surface attack of targets beyond the CFL without coordination with the ground commander in whose area the targets are located. Also called CFL. See also fire support. (Joint Pub 1-02)

counterbattery fire Fire delivered for the purpose of destroying or neutralizing indirect fire weapon systems. (JP 1-02) For naval surface combatants, counterbattery is defined as the specific case of defensive suppression or neutralization of either direct or indirect fires at own ship or other ships in company, using own ship weapons.

counterfire Fire intended to destroy or neutralize enemy weapons. Includes counterbattery, counterbombardment, and countermortar fire. (JP 1-02) In Army and Marine Corps usage, counterfire is both a preplanned and a reactive process of neutralizing and suppressing enemy indirect fire capabilities—sometimes referred to as the counterfire fire. For surface combatants, counterfire includes support of forces ashore by detecting, tracking and locating, with own sensor systems, enemy artillery, rockets, and missile launchers firing at those forces. The surface combatant would report these hostile targets to the coordination center and, where authorized and in a position to do so, execute fires against these positions with own ship weapons.

direct support A mission requiring a force to support another specific force and authorizing it to answer directly to the supported force's request for assistance. Also called DS. (Joint Pub 1-02)

direct supporting fire Fire delivered in support of part of a force, as opposed to general supporting fire which is delivered in support of the force as a whole. (Joint Pub 1-02)

electronic warfare Any military action involving the use of electromagnetic and directed energy to control the electromagnetic spectrum or to attack the enemy. Also called EW. The three major subdivisions within electronic warfare are: electronic attack, electronic protection, and electronic warfare support. a. electronic attack. That division of electronic warfare involving the use of electromagnetic, directed energy, or antiradiation weapons to attack personnel, facilities, or equipment with the intent of degrading, neutralizing, or destroying enemy combat capability and is considered a form of fires. Also called EA. EA includes: 1) actions taken to prevent or reduce an enemy's effective use of the electromagnetic spectrum, such as jamming and electromagnetic deception, and 2) employment of weapons that use either electromagnetic or directed energy as their primary destructive mechanism (lasers, radio frequency weapons, particle beams). b. electronic protection. That division of electronic warfare involving actions taken to protect personnel, facilities, and equipment from any effects of friendly or enemy employment of electronic warfare that degrade, neutralize, or destroy friendly combat capability. Also called EP. c. electronic warfare support. That division of electronic warfare involving actions tasked by, or under direct control of, an operational commander to search for, intercept, identify, and locate sources of intentional and unintentional radiated electromagnetic energy for the purpose of immediate threat recognition, targeting, planning and conduct of future operations. Thus, electronic warfare support provides information required for immediate decisions involving electronic warfare operations and other tactical actions such as threat avoidance, targeting, and homing. Also called ES. Electronic warfare support data can be used to produce signals intelligence, both communications intelligence, and electronics intelligence. See also command and control warfare. (Joint Pub 1-02)

engagement Employment of a specific weapon against a specific target.

final protective fire An immediately available prearranged barrier of fire designed to impede enemy movement across defensive lines or areas. (Joint Pub 1-02)

fires The effects of lethal or nonlethal weapons. (Joint Pub 1-02)

fire for effect That volume of fires delivered on a target to achieve the desired effect. Also called FFE. (Joint Pub 1-02)

fire support Fires that directly support land, maritime, amphibious, and special operations forces to engage the enemy forces, combat formations, and facilities in pursuit of tactical and operational objectives. (Joint Pub 1-02)

fire support area An appropriate maneuver area assigned to fire support ships by the naval force commander from which they can deliver gunfire support to an amphibious operations. (Joint Pub 1-02)

fire support coordination The planning and executing of fire so that targets are adequately covered by a suitable weapon or group of weapons. (Joint Pub 1-02)

fire support coordination center A single location in which are centralized communications facilities and personnel incident to the coordination of all forms of fire support. (Joint Pub 1-02)

fire support coordination line A fire support coordination measure that is established and adjusted by appropriate land or amphibious force commanders within their boundaries in consultation with superior, subordinate, supporting, and affected commanders. Fire support coordination lines (FSCLs) facilitate the expeditious attack of surface targets of opportunity beyond the coordinating measure. An FSCL does not divide an area of operations by defining a boundary between close and deep operations or a zone for close air support. The FSCL applies to all fires of air, land, and sea-based weapon systems using any type of ammunition. Forces attacking targets beyond an FSCL must inform all affected commanders in sufficient time to allow necessary reaction to avoid fratricide. Supporting elements attacking targets beyond the FSCL must ensure that the attack will not produce adverse effects on, or to the rear of, the line. Short of an FSCL, all air-to-ground and surface-to-surface attack operations are controlled by the appropriate land or amphibious force commander. The FSCL should follow well defined terrain features. Coordination of attacks beyond the FSCL is especially critical to commanders of air, land, and special operations forces. In exceptional circumstances, the inability to conduct this coordination will not preclude the attack of targets beyond the FSCL. However, failure to do so may increase the risk of fratricide and could waste limited resources. Also called FSCL. See also fire support; fires. (Joint Pub 1-02)

fire support coordinating measure A measure employed by land or amphibious commanders to facilitate the rapid engagement of targets and simultaneously provide safeguards for friendly forces. See also fire support coordination. (Joint Pub 1-02)

fire support group A temporary grouping of ships under a single commander charged with supporting troop operations ashore by naval gunfire. A fire support group may be further subdivided into fire support units and fire support elements. (Joint Pub 3-09, Joint Pub 1-02)

fire support station An exact location at sea within a fire support area from which a fire support ship delivers fire. (Joint Pub 1-02)

forward line of own troops A line which indicates the most forward positions of friendly forces in any kind of military operation at a specific time. The forward line of own troops (FLOT) normally identifies the forward location of covering and screening forces. The FLOT may be at, beyond, or short of the forward edge of the battle area. An enemy FLOT Also called FLOT. (Joint Pub 1-02)

free-fire area A specific area into which any weapon system may fire without additional coordination with the establishing headquarters. (Joint Pub 1-02.)

general support That support which is given to the supported force as a whole and not to any particular subdivision thereof. Also called GS. (Joint Pub 1-02)

Global Command and Control System Highly mobile, deployable command and control system supporting forces for joint and multinational operations across the range of military operations, any time and anywhere in the world with compatible, interoperable, and integrated command, control, communications, computers, and intelligence systems. Also called GCCS. (Joint Pub 1-02)

gun target line An imaginary straight line from the gun to the target. Also called GTL. (Joint Pub 1-02)

high-payoff target A target whose loss to the enemy will significantly contribute to the success of the own-force course of action. High-payoff targets are those high-value targets, identified through wargaming, which must be acquired and successfully attacked for the success of the friendly commander's mission. (Joint Pub 1-02)

high-value target A target the enemy commander requires for the successful completion of the mission. The loss of high-value targets would be expected to seriously degrade important enemy functions throughout the friendly commander's area of interest. (Joint Pub 1-02)

identification 1. The process of determining the friendly or hostile character of an unknown detected contact. 2. In arms control, the process of determining which nation is responsible for the detected violations of any arms control measure. 3. In ground combat operations, discrimination between recognizable objects as being friendly or enemy, or the name that belongs to the object as a member of a class. Also called ID. (Joint Pub 1-02)

integration 1. In photography, a process by which the average radar picture seen on several scans of the time base may be obtained on a print, or the process by which several photographic images are combined into a single image. 2. In force projection, the synchronized transfer of units into an operational commander's force prior to mission execution. (Joint Pub 1-02)

interdiction An action to divert, disrupt, delay or destroy the enemy's surface military potential before it can be used effectively against friendly forces. (Joint Pub 1-02)

interoperability 1. The ability of systems, units, or forces to provide services to and accept services from other systems, units, or forces and to use the services so exchanged to enable them to operate effectively together. 2. (DOD only) The condition achieved among communications-electronics equipment when information or services can be exchanged directly or satisfactorily between them and/or their users. The degree of interoperability should be defined when referring to specific cases. (Joint Pub 1-02)

joint fires Fires produced during the employment of forces from two or more components in coordinated action toward a common objective. (Joint Pub 1-02)

joint fires element The joint fires element is an optional staff element that provides recommendations to the J-3 to accomplish fires planning and synchronization. Also called JFE. See also fire support; joint fires. (Joint Pub 1-02)

joint fire support Joint fires that assist land, maritime, amphibious, and special operation forces to move, maneuver, and control territory, populations, and key waters. (Joint Pub 1-02)

joint force air component commander The joint force air component commander derives authority from the joint force commander who has the authority to exercise operational control, assign missions, direct coordination among subordinate commanders, redirect and organize forces to ensure unity of effort in the accomplishment of the overall mission. The joint force commander will normally designate a joint force air component commander. The joint force air component commander's responsibilities will be assigned by the joint force commander (normally these would include, but not be limited to, planning, coordination, allocation, and tasking based on the joint force commander's apportionment decision). Using the joint force commander's guidance and authority, and in coordination with other Service component commanders and other assigned or supporting commanders, the joint force air component commander will recommend to the joint force commander apportionment of air sorties to various missions or geographic areas. Also called JFACC. See also joint force commander.. (Joint Pub 1-02)

joint force commander A general term applied to a combatant commander, subunified commander, or joint task force commander authorized to exercise combatant command (command authority) or operational control over a joint force. Also called JFC. (Joint Pub 1-02)

joint suppression of enemy air defenses A broad term that includes all suppression of enemy air defense activities provided by one component of the joint force in support of another. Also called J-SEAD. (Joint Pub 1-02)

joint targeting coordination board A group formed by the joint force commander to accomplish broad targeting oversight functions that may include but are not limited to coordinating targeting information, providing targeting guidance and priorities, and preparing and/or refining joint target lists. The board is normally comprised of representatives from the joint force staff, all components, and if required, component subordinate units. Also called JTCB. (Joint Pub 1-02)

joint task force	A joint force that is constituted and so designated by the Secretary of Defense, a combatant commander, a subunified commander, or an existing joint task force commander. Also called JTF. (Joint Pub 1-02)
land attack	The integrated employment of forces for projecting combat power into and on the ground portion of the battlespace in order to protect national vital interests and to achieve national and military objectives. (N76 SCLAW guidance document)
landing force	A task organization of troop units, aviation and ground, assigned to an amphibious assault. It is the highest troop echelon in the amphibious operation. Also called LF. (Joint Pub 1-02)
mission	1. The task together with the purpose, that clearly indicates the action to be taken and the reason therefore. 2. In common usage, especially when applied to lower military units, a duty assigned to an individual or unit; a task. 3. The dispatching of one or more aircraft to accomplish one particular task. (Joint Pub 1-02)
nautical mile	A measure of distance equal to one minute arch on the Earth's surface. The United States has adopted the international nautical mile equal to 1,852 meters or 6,076.11549 feet. Also called nm. (Joint Pub 1-02)
naval gunfire support	Fire provided by Navy surface gun systems in support of a unit or units tasked with achieving the commander's objectives. A subset of naval surface fire support. Also called NGFS. See also naval surface fire support. (Joint Pub 1-02)
naval surface fire support	Fire provided by Navy surface gun, missile, and electronic warfare systems in support of a unit or units tasked with achieving the commander's objectives. Also called NSFS. (Joint Pub 1-02)
neutralization fire	Fire that is delivered to render the target ineffective or unusable. (Joint Pub 1-02)
no-fire area	A land area designated by the appropriate commander into which fires or their effects are prohibited. Also called NFA. See also fires. (Joint Pub 1-02)
planned target	In artillery and naval gunfire support, a target on which fire is prearranged. (Joint Pub 1-02)
restrictive fire area	An area in which specific restrictions are imposed and into which fires that exceed those restrictions will not be delivered without coordination

with the establishing headquarters. Also called RFA. See also fires. (Joint Pub 1-02)

restrictive fire line — A line established between converging friendly surface forces that prohibits fires or their effects across that line. Also called RFL. See also fires. (Joint Pub 1-02).

sensors — Equipment which detects, and may indicate, and/or record objects and activities by means of energy or particles emitted, reflected, or modified by objects. (DoD military terms)

Naval organic sensors and systems are those ship-based or ship-deployed subsystems that operate and are controlled as an integrated element of the ship system. Ship-based examples include ship-installed sensors such as radar or electro-optical sensor deployed subsystems, and ship-deployed systems include vehicles with sensor payloads controllable from the ship such as LAMPS MKIII and the VTUAV.

Naval non-organic systems are systems not designed as an integral or controlled element of the ship system but can nevertheless be linked to or operationally tasked to assist in ship mission objectives remaining under the direct control of a non ship-based operator. Examples include Joint Surveillance Target Attack Radar System (JSTARS), maritime patrol aircraft (MPA), Theater UAV, spaced-based assets, etc.

strategic attack — Direct attacks against the enemy strategic centers of gravity, his war making capacity and his will to make war. (JP 3-56.1) This system includes the vital military and economic targets that constitute a nation's war making capability and those targets essential to postwar recovery. (Air Force Pamphlet 14-210)

strike — An attack that is intended to inflict damage on, seize, or destroy an objective. (Joint Pub 1-02) Strike includes strategic attack, interdiction, and close air support. (Air Force Pamphlet 14-210)

support:

- **mutual support** — That support which units render each other against an enemy, because of their assigned tasks, their position relative to each other and to the enemy, and their inherent capabilities. (Joint Pub 1-02)
- **general support** — 1. That support which is given to the supported force as a whole and not to any particular subdivision thereof. 2. (DOD only) A tactical artillery mission. Also called GS. (Joint Pub 1-02)

direct support Direct support is a mission requiring a force to support another specific force and authorizing it to answer directly the supported force's request for assistance. (MCRP 5-2A)

close support That action of the supporting force against targets or objectives that are sufficiently near the supported force as to require detailed integration or coordination of the supporting action with fire, movement, or other actions of the supported force. (Joint Pub 1-02)

supporting fire Fire delivered by supporting units to assist or protect a unit in combat. See also direct supporting fire. (Joint Pub 1-02)

supporting arms coordination center A single location on board an amphibious command ship in which all communication facilities incident to the coordination of fire support of the artillery, air, and naval gunfire are centralized. This is the naval counterpart to the fire support coordination center utilized by the landing force. Also called SACC. See also fire support coordination center. (Joint Pub 1-02)

suppression of enemy air defenses That activity which neutralized, destroys, or temporarily degrades surface-based enemy air defenses by destructive and/or disruptive means. Also called SEAD. See also electronic warfare. (Joint Pub 1-02)

suppressive fire Fires on or about a weapons system to degrade its performance below the level needed to fulfill its mission objectives, during the conduct of the fire mission. (Joint Pub 1-02).

tactical air command center The principal US Marine Corps air command and control agency from which air operations and air defense warning functions are directed. It is the senior agency of the US Marine air command and control system which serves as the operational command post of the aviation combat element commander. It provides the facility from which the aviation combat element commander and his battle staff plan, supervise, coordinate, and execute all current and future air operations in support of the Marine air-ground task force. The tactical air command center can provide integration, coordination, and direction of joint and combined air operations. Also called Marine TACC. (MCWP 3-25.3)

tactical air control center The principal air operations installation (ship-based) from which all aircraft and air warning functions of tactical air operations are controlled. Also called Navy TACC. (Joint Pub 1-02)

target 1. A geographic area, complex, or installation planned for capture or destruction by military forces. 2. In intelligence usage, a country, area, installation, agency, or person against which intelligence operations are directed. 3. An area designated and numbered for future firing. 4. In gunfire support usage, an impact burst which hits the target. (Joint Pub 1-02)

target acquisition The detection, identification, and location of a target in sufficient detail to permit the effective employment of weapons. (Joint Pub 1-02)

target of opportunity 1.A target visible to a surface or air sensor or observer that is within range of available weapons and against which fire has not been scheduled or requested. 2. A nuclear target observed or detected after an operation begins that has not been previously considered, analyzed, or planned for a nuclear strike. Generally fleeting in nature, it should be attacked as soon as possible within the time limits imposed for coordination and warning of friendly troops and aircraft. (Joint Pub 1-02)

target report Target reports provide essential information on targets and suspected targets. These data include: Reporting agency; Type of sensor; Date-time group of acquisition by the sensor; Date-time group of the report; Description of the target; target activity (moving, stationary, etc.); Dwell time based on the likelihood that the target will move; Size of the target; Target location and altitude; Target posture (dug-in, in built-up areas, in the open, etc.) Target Location Error (TLE). (FM 6-20-10/ MCRP 3-1.6.14)

targeting 1. The process of selecting targets and matching the appropriate response to them, taking account of operational requirements and capabilities. 2. The analysis of enemy situations relative to the commander's mission objectives, and capabilities at the commander's disposal, to identify and nominate specific vulnerabilities, that if exploited, will accomplish the commander's purpose through delaying, disrupting, disabling, or destroying enemy forces critical to the enemy. See also joint targeting control board. (Joint Pub 1-02)

targeting process:

decide In the decide phase, target categories are identified for engagement. Fire support, intelligence, and operations personnel decide what targets to look for, where the targets can be found on the battlefield, who can locate the targets, and how the targets should be attacked based on the commander's intent and desired end state. (Joint Pub 3-09)

detect The detect phase is designed to acquire the targets selected in the decide phase. Target acquisition assets and agencies execute the intelligence collection plan and focus on specific areas of interest. Tracking is an essential element of the detection function. Tracking is based on the commander's concept of operation and targeting priorities. (Joint Pub 3-09)

deliver The deliver phase involves selecting the right attack system (both lethal and nonlethal) and attacking the specific threat functions in accordance with the attack guidance. (Joint Pub 3-09)

assess Assess is the estimate of damage resulting from the use of military force, either lethal or nonlethal, against a target. Assessment requires extensive coordination between operational and intelligence elements to be effective, timely, and accurate. A key element of the assess function is the decision as to whether the target requires reattack in order to achieve the desired level of effects specified by the commander. (Joint Pub 3-09)

attack guidance matrix A targeting process product that the supported maneuver unit commander uses to describe which preplanned target types will be attacked, how they will be attacked, when they will be attacked, and the desired effects. Also called AGM. (FM 6-20-10/MCRP 3-1.6.14 Tactics, Techniques and Procedures for the Targeting Process)

target selection standards Target selection standards are criteria applied to enemy activity which are used to decide whether the activity is a target. Targets are those activities that meet the accuracy (TLE) and timeliness requirements for attack. Suspected targets are those activities which fail to meet the accuracy and timeliness requirements for attack, and must be confirmed before being attacked. Also called TSS. (FM 6-20-10/MCRP 3-1.6.14 Tactics, Techniques and Procedures for the Targeting Process)

Tomahawk strike network A dedicated communications network using a 5-kHz or 25-kHz UHF SATCOM channel. It must be established before the start of a strike and allows two-way communications between the strike or missile controller and Tactical Tomahawk missiles. The means for the missile to send health and status messages and/or images to the strike or missile monitor and for the strike or missile controller to send in-flight mission modification messages to the missiles.

unmanned aerial vehicle — A powered, aerial vehicle that does not carry a human operator, uses aerodynamic forces to provide vehicle lift, can fly autonomously or be piloted remotely, can be expendable or recoverable, and can carry a lethal or nonlethal payload. Ballistic or semiballistic vehicles, cruise missiles, and artillery projectiles are not considered unmanned aerial vehicles. Also called UAV. (Joint Pub 1-02)

WARFARE:

strategic level of war — The level of war at which a nation, often as a member of a group of nations, determines national or multinational (alliance or coalition) security objectives and guidance, and develops and uses national resources to accomplish these objectives. Activities at this level establish national and multinational military objectives; sequence initiatives; define limits and assess risks for the use of military and other instruments of national power; develop global plans or theater war plans to achieve these objectives; and provide military forces and other capabilities in accordance with strategic plans. (Joint Pub 1-02)

operational level of war — The level of war at which campaigns and major operations are planned, conducted, and sustained to accomplish strategic objectives within theaters or areas of operations. Activities at this level link tactics and strategy by establishing operational objectives needed to accomplish the strategic objectives, sequencing events to achieve the operational objectives, initiating actions, and applying resources to bring about and sustain these events. These activities imply a broader dimension of time or space than do tactics; they ensure the logistic and administrative support of tactical forces, and provide the means by which tactical successes are exploited to achieve strategic objectives. (Joint Pub 1-02)

tactical level of war — The level of war at which battles and engagements are planned and executed to accomplish military objectives assigned to tactical units or task forces. Activities at this level focus on the ordered arrangement and maneuver of combat elements in relation to each other and to the enemy to achieve combat objectives. (Joint Pub 1-02).

zone of fire — An area into which a designated ground unit or fire support ship delivers, or is prepared to deliver, fire support. Fire may or may not be observed. (Joint Pub 1-02)

APPENDIX B—PROGRAMS, SYSTEMS, AND CAPABILITIES

This appendix covers the surface combatant's weapon's platforms and systems, command control and communications systems, and target acquisition systems. Furthermore it describes existing and program of record capabilities.

SURFACE COMBATANTS

Arleigh Burke Class Aegis Guided-Missile Destroyer

Description

Arleigh Burke (DDG 51) class destroyers employ an integrated architecture with four subsystems—AN/SPY-1 multifunction radar, command and decision system (C&D), Aegis display system (ADS), and the weapon control system. Some land attack weapons such as Tomahawk are not integrated with the Aegis combat system. The DDG 51 class has either 90 or 96 available cells for missile weapons.[1] TLAM's range is between 700 and 1,000 nautical miles (nm) depending on the variant. DDGs 51 through 80 are equipped with a single Mk 45 Mod 2, 5-inch/54-caliber gun capable of firing conventional ballistic ammunition to a range of 13nm. DDGs 81 and above are equipped with the upgraded Mk 45 Mod 4, 5-inch/62-caliber gun capable of firing the extended range guided munition (ERGM) with an objective range of 63nm, as well as all current conventional ordnance to a range of 21nm.

Operational Impact

Tomahawk missiles and enhanced 5 inch/62-caliber guns provide a versatile, all weather, land attack capability for both NSFS and NSS missions.

Program Status

The first of the Arleigh Burke class Aegis guided-missile destroyers was commissioned in 1991. As of June 2002, DDGs 51 through 86 have been commissioned, DDGs 87 through 91 are near completion or under construction, and DDGs 92 through 113 have been authorized. The composition of the land attack systems on DDGs 97 through 113 has not been specified.

Arleigh Burke Flight IIA Class Destroyer USS Oscar Austin (DDG 79)

[1] DDGs 51 through 78 have 90 vertical launch system (VLS) cells; and DDGs 79 through 107 have 96 VLS cells.

Cruiser Conversion Program

Description

The conversion program for 22 ships of the CG 47 Ticonderoga-class cruiser is a critical element of the overall ship modernization plan. This mid-life refurbishment program extends the Ticonderoga class's service life to 40 years. One of the key components of cruiser conversion is to provide these ships with an upgraded land attack capability in addition to other warfighting improvements. The vision is to convert as many as 14 ships to an enhanced land attack capability depending on funding available. Upgrades are scheduled to commence in 2005 and include:

- **Gun Weapon System (GWS) Upgrades**. The GWS will be upgraded by replacing the two existing 5-inch/54-caliber guns with two 5-inch/62-caliber guns. Also, the Mk 160 Mod 11 GCS and two Mk 46 Mod 1 optical sight systems will replace the Mk 86 gun fire control system. Magazine stowage flexibility will also be enhanced with the installation of the universal tie down system in both forward and aft magazines.
- **TTWCS + NFCS (T+N) Installation.** Cruisers with enhanced land attack capability will receive the T+N set of systems along with TACTOM. Further upgrades to NFCS are required for the cruiser to be able to perform the role of controlling unit, where a single ship can direct the fires of several ships.

Operational Impact

T+N, TACTOM, and enhanced 5-inch/62-caliber guns will improve the littoral warfare, NSFS, and NSS effectiveness. This conversion program will ensure the relevance of these ships in the future, and is vital for the Navy to meet the future warfighting requirements for NSFS and NSS missions.

Program Status

The cruiser conversion program is funded through the FYDP for 9 baseline-3/4 and 1 baseline-2 cruisers. Research and development for the program is funded in FY04 and 05, however, commercial off-the-shelf (COTS) refresh remains an unfunded requirement. Beginning in FY06, the cruiser conversion profile is 1-2-3-3. One baseline-2 cruiser is funded for conversion in FY10.

Ticonderoga Class Cruiser USS Vella Gulf (CG 72)

Surface Combatant Family of Ships (SCFoS)

Description

The award of the DD(X) Design Agent contract in June 2002 signals the start of a transformation for the Navy's surface combatant fleet, with the development of technologies that will create new capabilities while reducing crew size and yielding significant combat advantage. DD(X) is the foundation of the SCFoS, including a future cruiser, CG(X), and littoral combat ship (LCS), providing the nation with a balanced set of warfighting capabilities to meet the national security requirements in the 21st Century.

DD(X) will build on the innovative engineering and technologies of the DD-21 program and will continue development and prototype testing of the critical major subsystems including the advanced gun system and its munitions, the SPY-3/volume search radar suite, the integrated power system, signatures management, and optimal manning technologies. As the technologies mature, they will be incorporated into other Navy programs to improve performance, reduce cost, and to serve as the technological basis for future naval platforms.

Operational Impact

President Bush has made transformation of the Department of Defense a high priority. Through SCFoS, the Navy has charted a transformational course that will provide capability across the full spectrum of naval warfare. The Navy's strategy projects power, supports assured access to littoral regions, and develops the capability to defeat air and missile threats.

Program Status

The initial SCFoS contract to be awarded in 2005 will fund two RDT&E DD(X) ships. Follow-on contracts could end up totaling $100 billion for some 70 warships in the SCFoS: destroyers, cruisers, and the LCS. The cruiser and destroyer are expected to share a common hull design. The LCS will most likely have an advanced hull designed for high speed and a shallow draft.

DD(X) Proposed Engineering and Technology Concepts

Spruance-Class Destroyers

Description

Originally designed for the primary mission of anti-submarine warfare, DD-963 Spruance-class destroyers also have the ability to engage ships, aircraft, and shore targets. Originally fitted with two Mk 45 lightweight 5-inch/54-caliber guns, to improve their land attack capabilities, 24 of the 31 Spruance-class destroyers have been back-fitted with Tomahawk land attack missiles (TLAM) using the Mk 41 Vertical Launch System (VLS). Each ship carries 61 VLS cells.[2] The Mk 45 Mod 2, 5-inch/54-caliber gun has a range of 13nm and TLAM's range is between 700 and 1,000nm depending on the variant.

Operational Impact

The Spruance-class destroyer's inherent capabilities make it an ideal ship for surveillance operations. The ship's four gas turbine engines give the destroyer endurance and responsiveness; and allow it to conduct such operations with little notice and with less fuel logistics concerns. Its VLS and guns give the destroyer the ability to conduct both NSFS and NSS missions.

Program Status

The Navy plans to accelerate the decommissioning of Spruance-class destroyers at a rate of about six per year. The last Spruance-class destroyer is expected to be decommissioned in 2006.

Spruance Class Destroyer USS John Rodgers (DD-983)

[2] All non-VLS equipped Spruance-class ships have been decommissioned.

WEAPONS

Tomahawk Land Attack Missile (TLAM) Block II and Block III

Description

Tomahawk is an all-weather, highly survivable, ship or submarine-launched land-attack cruise missile. Its main role is all-weather attack against targets in high-threat areas, especially at extended range. The conventional version has two variants: the TLAM-C with a unitary warhead and the TLAM-D with a submunition warhead. These missiles fly to a maximum range of 800nm. The last conventional Block II missiles have been withdrawn from fleet issue for upgrade to Block III. Block III missiles have an improved engine, and the unitary warhead version provides equivalent lethality to the Block II's warhead with reduced weight. The improvements in the Block III missile significantly extend maximum missile range, and the improved engine also provides extremely precise time of arrival (TOA) control.

Missile survivability depends mainly on three factors. The missile normally flies at a very low altitude, flying below radar detection envelopes or minimizing exposure to them. Survivability also is enhanced because the missile provides a limited radar cross-section. Finally, the turbofan engine exhibits a reduced heat signature.

Block II missile navigation employed digitized terrain mapping and the missile's radar altimeter in a system known as Terrain Contour Matching (TERCOM) for the initial updates to the missile's inertial navigation set (INS). Mission planners had to include several TERCOM maps in Block II missions. Once missile position uncertainty is sufficiently reduced, missile navigation shifts to the optically based Digital Scene Matching Area Correlator (DSMAC) system for updates to the INS. DSMAC is a highly dependable, all-weather, day or night system that provides extremely precise and accurate navigation to the mission aimpoint. Block III missiles can employ all of the navigation capabilities of the Block II, and also have Global Positioning System (GPS) navigation. The jam-resistant GPS system employed by the Block III missile gives mission planners increased options for route planning because they are not restricted to paths that can support TERCOM and DSMAC navigation. Use of GPS also speeds up the mission planning process. Block III missiles can fly GPS-only missions, but mission planners can use any of the available navigation update systems.

Operational Impact

Tomahawk missiles provide 24-hour, all-weather strike capability. Tomahawk is mainly used for precise strikes against specific aimpoints on high-payoff targets in heavily defended areas, such as communications sites and air defense sites, and often at extended ranges. Tomahawk Block III strike missions are planned and directed by unified, joint, and battle group commanders. Strike planners select, task, and coordinate Tomahawk strike tasking, and the launch area coordinator (LAC) coordinates execution of the TLAM missions.

Program Status

The Block III missiles are fully deployed capabilities from the Baseline III program. These missiles currently operate in maintenance status, but Block III missiles with the unitary warhead will be able to employ launch platform mission planning (LPMP) missions produced by the Tactical Tomahawk Weapon Control System (TTWCS), a capability funded in the Baseline IV program. TTWCS will be able to use submunition and unitary variants of Block III missiles on TPS planned missions as well.

Tomahawk Block III Missile in Flight

Tomahawk Land Attack Missile, Block IV (Tactical Tomahawk (TACTOM))

Description

The Block IV, or "Tactical Tomahawk" missile is a major redesign of the TLAM that greatly reduces the cost of each all-up round (AUR). The airframe includes fewer components and the reliability improvements extend the maintenance interval to 15 years for each AUR. Like the Block III missiles, Block IV Tomahawk is an all-weather, highly survivable cruise missile that can be launched from surface combatants or submarines. The TLAM redesign employs up-to-date components that bring improvements to core missile navigation, guidance, and communications subsystems, as well as a major increase in missile range. The Block IV missile has only one variant, the conventional TLAM-C with a unitary warhead. Missile survivability is expected to match that of Block III missiles because the missile maintains reduced signatures and the capability to fly missions at low altitudes.

Block IV missile navigation employs an enhanced, anti-jam GPS navigation capability and DSMAC as the main sources of navigation updates to the INS. Mission planners also can employ TERCOM navigation updates as a backup navigation capability for Block IV missiles. Anti-jam GPS capability improves resistance to airborne and ground-based GPS jamming. A ring-laser gyro guidance set and its embedded software greatly reduce missile alignment times, thereby delivering increased tactical responsiveness. In addition to missions planned by the Tomahawk Planning System (TPS), Block IV missiles can also employ GPS-only missions planned with the launch platform mission planning capability in the Tactical Tomahawk Weapon Control System (TTWCS).

Block IV missiles include a satellite data link transceiver (SDLT) enabling two-way communication between the missiles and controlling locations via the Tomahawk Strike Network (TSN). The TSN supports a number of Block IV unique capabilities, such as in-flight retargeting, en route flex, loiter tactics for responsive strikes against on-call targets and unplanned targets, and in-flight reporting. Near-real time in-flight reports from the missile include periodic and event-based health and status reports, battle damage indications (BDI) health and status reports that provide estimated CEP prior to the terminal maneuver, and en route battle damage indications imagery (BDII) from the DSMAC camera. Controlling locations can send in-flight mission modification messages (IMMM) to individual missiles ordering them to attack a new target (in-flight retargeting), or to attack an alternative outcome on a multiple-outcomes-capable mission. Multiple outcome missions can be planned with up to 15 possible outcomes, any one of which can be selected prior to launch. If the controller sends an en route flex IMMM prior to the missile arriving at a branch point in a multiple outcomes-capable mission, the missile can be redirected to an alternative, preplanned outcome included in the mission plan.

The Tactical Tomahawk missile features a flexible architecture that can support future advances in missile capabilities, and alternative payloads (such as a hardened target penetrator or submunitions).

Operational Impact

The Tactical Tomahawk is a key enabler of increased responsiveness in the Baseline IV Tomahawk Weapon System. The key features improving responsiveness are the reduced alignment time prior to launch, launch platform mission planning capability, and the T+N. The T+N enables the capabilities that support responsive tactics like in-flight retargeting, en route flex to alternative outcomes, and loiter. The BDII and BDI capabilities will provide near-real time indications of strike effectiveness to command and control locations during restrike decision-making.

Program Status

The initial operational capability for Tactical Tomahawk is scheduled for 2004. Tactical Tomahawk is a major element of the Baseline IV, Phase 1 upgrade to the Tomahawk Weapon System and it complements concurrent upgrades to mission planning, command and control, and firing unit weapon control systems. The Baseline IV Phase 2 requirements have not yet been completed.

Tactical Tomahawk Captured Flight Test
17 May 2002, NSWC, Indian Head, MD

5-Inch Ballistic Projectiles

Description

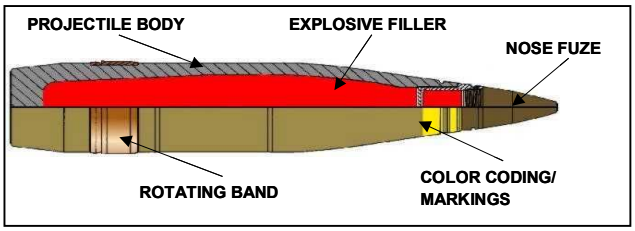
Existing 5-inch ammunition consists of a family of spin-stabilized ballistic projectiles with a variety of fuzes (i.e., timed, point detonating, infrared proximity, and radio frequency proximity) and warheads (i.e., high explosive, illumination) required to perform various missions. Existing projectiles weigh about 70 pounds and can be fired using a standard Mk 67 (full service) charge to ranges of about 13nm or Mk 68 reduced charges to shorter ranges.

Operational Impact

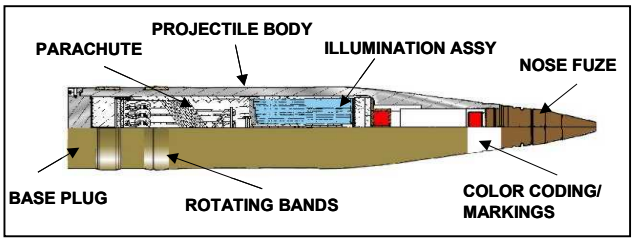
The 5-inch ballistic round of ammunition fired from cruiser and destroyer type combatant ships is used against air, surface, and shore targets. Its 13nm range limits the effectiveness of the existing ammunition.

Program Status

The Department of the Navy budgeted $35.6M in FY02 to procure approximately 10,000 rounds of 5-inch gun ammunition, fuzes, and primers. The Navy continues to budget and procure a variety of 5-inch gun ammunition.



Typical 5-inch High Explosive Projectile



Typical 5-inch Illumination Projectile

Cargo Projectile (Ex 172)

Description

The existing family of ballistic ammunition has been enhanced by the development of the 5-inch cargo projectile. This new projectile is designed to meet the gun and conventional ammunition thresholds and objectives of the 5-inch/62-caliber gun ORD Serial Number 420-86-95. The current maximum operation range for existing cargo projectiles (illumination load) is approximately 9nm. To achieve the longer ranges as specified in the ORD, the exterior shape of the cargo projectile was based on the current Mk 81 high-fragmentation (HI-FRAG) projectile. The new projectile is designed to meet the conventional ammunition threshold range of 13nm and objective range of 21nm.[3]

The cargo projectile has a universal cylindrical interior cavity for carrying a wide variety of munition loads and an Ex 432 electronic time (ET) fuze.[4] The baseline cargo projectile program consists of the Ex 176 (Mk 23 illumination load) variant of the cargo projectile.

Operational Impact

The longer range cargo projectile and Mk 82 HI-FRAG unitary warhead projectile will help provide the inexpensive volume fire that is critical during the initial stages of forcible entry operations.

Program Status

The existing Mk 82 HI-FRAG projectile was being qualified to reach the objective range of 21nm when it was discovered that the existing fleet issue nylon discarding rotating band could not withstand the forces associated with the high energy propelling charge. An effort was initiated in FY02 to design a new rotating band that could withstand the forces and be retrofitable to both existing fleet issued HI-FRAG projectiles and the cargo projectile bodies which are currently in production. The initial operational capability (IOC) for the Mk 23 illumination payload is planned for end of FY03. The extended range (21nm) capability is anticipated for early FY04.

Cargo Projectile with Mk 23 Illumination Payload

[3] The objective range of 21nm can be attained only when using a high energy propelling charge and the Mk 45 Mod 4 gun. The Ex 175 propelling charge is currently in development to achieve this extended range performance capability.

[4] The Ex 432 ET fuze is a modification of the Army's M762A1 electronic time fuze. The modifications include changes for compatibility with the Mk 34 electronic fuze setter in the Mk 45 gun mount and changes to meet Navy insensitive munition requirements.

Extended Range Guided Munition (ERGM)

Description

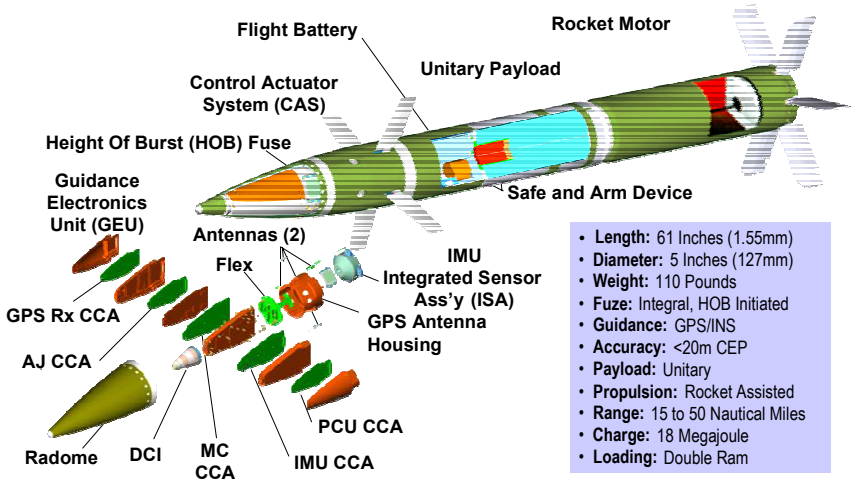
ERGM is a rocket-assisted, glide trajectory, gun-launched projectile that weighs about 110 pounds. With the Ex 167 propelling charge that provides approximately 18 megajoules launch energy, ERGM will achieve ranges in excess of 41nm. It has an objective range of 63nm. ERGM uses GPS to update its inertial navigation system for precise flight control to the target. The ERGM will have a unitary blast/fragmentation warhead. ERGM is designed to be fired from the 5-inch/62-caliber gun. Before firing, ERGM will be initialized by the Mk 34 GWS with own ship location, aim point, GPS, and meteorological data. ERGM will use this data to fly an optimal trajectory to the target.

Operational Impact

ERGM will provide surface combatants with projectiles with an increased range of up to 63nm and precision guidance to support forces ashore with responsive, accurate firepower at almost five times the range of conventional ballistic munitions. The ERGM gains enhanced accuracy by combining an inertial navigation system and GPS. The maneuverability of the ERGM round enables the use of the multiple round simultaneous impact (MRSI) capability. With MRSI it is possible to fire up to nine rounds from one gun and have them all arrive on target at the same time providing coverage over a broad area. The unitary warhead will provide surface combatants with an effective weapon against troops and lightly armored objects. The effectiveness of the unitary warhead is maximized with the capability of arriving at the target near vertically.

Program Status

The IOC of this new projectile is FY06. ERGM successfully completed a full chamber pressure guided gunfire test in June 2002. This test also demonstrated the capability to reach a range of 50nm. The test met all objectives including canard deployment, rocket motor operation, telemetry function, and GPS acquisition and track as well as the objective goal for accuracy. Production buy is 300 projectiles per year beginning in FY06.



ERGM Projectile Artist's Concept

Autonomous Naval Support Round (ANSR)

Description

The ANSR is being developed as a advanced concept technology demonstration (ACTD) program to achieve a long-range, fast response, low cost, and volume fire projectile. The design incorporates the improvements in guidance electronics, warhead, and rocket motor design. ANSR has a small nose mounted guidance section, moderate sized warhead, large rocket motor, and improved tail assembly. It is designed to be fired from Mk 45 Mod 2 5-inch/54-caliber gun that is standard on the older DDG 51 Block I & II ships and could be fired from the higher pressure Mk 45 Mod 4 5-inch/62-caliber gun. The preliminary conclusion from the demonstration is that the aeronautical and airframe data directly supports over 60nm, 5-inch range and 100nm, 155mm range for a tactical ANSR projectile.

Operational Impact

The ANSR has a longer range, higher speed, and greater ability to damage or destroy targets than existing 5-inch high-explosive ammunition. Greater accuracy is also achieved with a miniaturized guidance package that combines GPS with commercial-off-the-shelf inertial sensors.

Program Status

In January 2002, the Navy conducted a successful gun-launched test of the ANSR. An unguided projectile was fired from a standard Navy 5-inch/54-caliber gun to a range of 51nm with a time of flight of approximately 3 minutes. A guided projectile test flight is scheduled for late 2002. The development of ANSR has been sustained through directed congressional funding in order to transition it to an acquisition program during FY04.

5-inch Autonomous Naval Support Round

Long Range Land Attack Projectile (LRLAP)

Description

The long range land attack projectile (LRLAP) is being developed for the 155mm AGS. The LRLAP draws on the proven gun-hardened technology of the ERGM being developed for the U.S. Navy and the Excalibur (XM982) projectile to be employed by the U.S. Army and U.S. Marine Corps. The commonality among the three weapon systems will make the LRLAP affordable and compatible with new technology.

Operational Impact

LRLAP will provide the DD(X) surface combatants with projectiles with a dramatically increased range and precision guidance to support forces ashore with responsive, accurate firepower at almost eight times the range of conventional ballistic munitions. The objective range of the LRLAP is 100nm.

Program Status

An airframe structure test of the LRLAP was conducted in November 2001. The test, using a representative projectile with the same physical dimensions, features and specifications as a full-up tactical round, met all objectives, requirements and success criteria. The test, using a 6-inch/57-caliber prototype of an advanced gun system was conducted at Dugway Proving Grounds, Utah. Test objectives included base fin deployment, obturator function, and igniter retention. Delivery of test rounds is expected in FY09.

LRLAP Artist's Concept

WEAPONS/FIRE CONTROL SYSTEMS

Advanced Tomahawk Weapon Control System (ATWCS)

Description

The surface combatant's Advanced Tomahawk Weapon Control System (ATWCS) performs engagement planning, missile preparation, and launch control functions for missiles executing TLAM missions assigned to the ship. Firing units equipped with ATWCS cannot employ Block IV missiles, but they can use all Block II and Block III Tomahawk missiles variants. ATWCS also supports situational awareness functions for operators by incorporating surface track information from external sources like Link-11 and GCCS-M.

The ATWCS was designed for Tomahawk Weapon System Baseline III and replaced the original TWCS with commercial off-the-shelf (COTS)-based hardware and software. ATWCS incorporated an open-system architecture, eliminated stand-alone desktop computers, and enhanced command and control through accelerated mission processing.

Operational Impact

ATWCS enables shipboard operators to generate and maintain a non-real time surface track data base in a given theater of operations, to coordinate strike activities both on own-ship and with other firing units in a battle group, to plan Tomahawk engagements, and to initialize, prepare, and launch Tomahawk missiles.

Program Status

ATWCS is deployed in the fleet and the program continues to incorporate enhancements programmed under Tomahawk Weapon System Baseline III. ATWCS will remain in the fleet through 2015.

Tactical Tomahawk Weapon Control System (TTWCS)

Description

The Tactical Tomahawk weapon control system is the weapon control system created for the Baseline IV upgrade to the Tomahawk weapon system. TTWCS will be installed aboard surface combatants and submarines for engagement planning and missile launch functions, and for missile monitoring and control functions for Block IV missiles. Operators can also use launch platform mission planning functions to build GPS-only missions for execution by Block III and Block IV TLAM-C missiles. TTWCS works with all Tomahawk missile types, but is the only Tomahawk weapon control system capable of employing the TACTOM missile. The TTWCS also serves as the foundation for Phase 1 of the T+N land attack system, in which it serves as the Tomahawk component, while providing the hardware host for the land attack missile mission planning and NFCS software.

Operational Impact

TTWCS is the only weapon control system capable of employing the TACTOM missile. Ships with TTWCS will be able to employ any conventional Tomahawk missile, but other non-TTWCS ships will be limited to operations with Block II and Block III weapons. TTWCS units also will have the ability to monitor in-flight reporting from TACTOM missiles, including BDI imagery and BDI health and status reports, as well as the capability to send IMMMs for en route flex or in-flight retargeting to missiles they launched. TTWCS will also provide the ship with an onboard capability to plan missions for Block III TLAM-C and Tactical Tomahawk missiles, providing another option for responsive fires against targets ashore.

Program Status

The initial operational capability for TTWCS is limited to Block II and Block III missiles and is scheduled for IOC in 2003. Full TTWCS capabilities should be IOC in 2004 as part of the Baseline IV, Phase 1 upgrade to the Tomahawk weapon system and TTWCS complements concurrent upgrades to mission planning, command and control, and AUR components of the system. The Baseline IV Phase 2 requirements for TTWCS have not yet been completed.

Gun Weapon System (GWS)

Description

The Mk 34 GWS consists of the Mk 45 lightweight gun mount, the Mk 160 gun computer system (GCS), and the Mk 46 electro-optical sight system (EOSS). The Mk 34 GWS is installed on DDG 51 class Aegis destroyers and is being planned as part of the Aegis cruiser conversion program.

The gun mount loader drum contains ready-service autoloader capacity for up to 20 ballistic rounds or 10 ERGM rounds, or a mix of ballistic and ERGM rounds. Additionally, the gun mount is provided with magazine stowage of up to 750 rounds of ballistic ammunition or a mix of 232 ERGM and 225 ballistic rounds.

From the ready-service loader drum, the gun can fire single rounds or salvos at a continuous rate of up to 20 rounds per minute for conventional length projectiles. The longer ERGM rounds require a double ram cycle, and therefore have a firing rate that is limited to about 10 rounds per minute. As the loader drum is emptied, rounds must be resupplied via the lower hoist from the magazine. Ammunition from magazine stowage racks is manually transferred to the lower hoist. Therefore, the sustained firing rate of the gun mount is limited by the rate that ammunition can be manually handled in the magazine. The sustained rate of fire is about 8 to 12 rounds per minute for ballistic ammunition, depending on the ability of the magazine crew. For ERGM, the magazine will have a handling assist system that will allow loading the 110 pound ERGM rounds at a sustained rate of about two to four rounds per minute.[5]

Operational Impact

The Mk 45 Gun Mount, along with the Mk 34 GWS is used against surface ships, close hostile aircraft, and supporting forces ashore. The GWS receives information, alerts, and orders from shipboard sensors and off ship sources. It uses standard 5-inch ammunition. Starting with DDG 81, all future DDGs will be equipped with the 5-inch/62-caliber Mk 45 Mod 4 gun. Based on the existing 5-inch/54-caliber gun, the Mod 4 incorporates an adaptable digital control system that supports the new GCS and ERGM interface requirements. A longer barrel, structural enhancements, and a higher energy propellant charge allow for an increase in muzzle energy from 10 to about 18 megajoules that is required to achieve longer ranges. The Mod 4 gun will also be capable of firing all existing conventional ammunition using the conventional propellant charge.

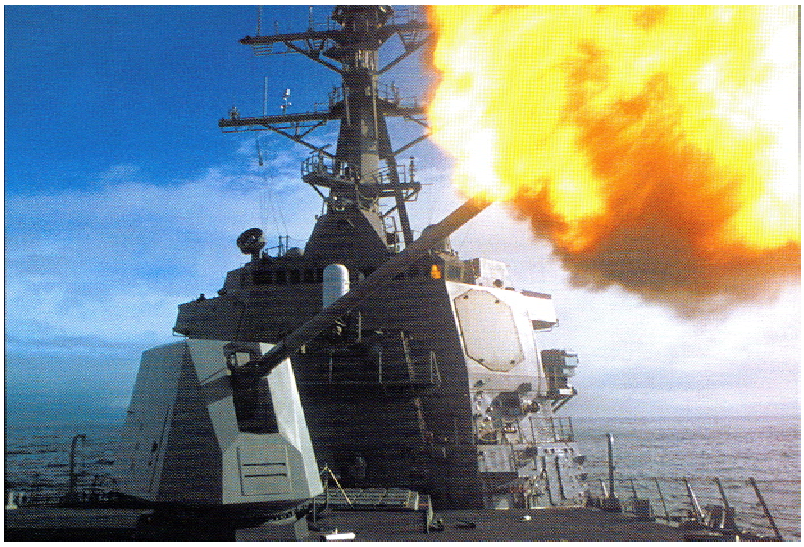
Program Status

The GWS is integrated with the DDG 51 combat system. It was developed to improve DDG 51's capabilities against air, surface, and shore threats. The GWS for cruiser conversion will be upgraded by replacing the existing guns with 5-inch/62-caliber guns. Also, the Mk 160 Mod 11 GCS and two Mk 46 Mod 1 optical sight systems will replace the Mk 86 gun fire control system. Magazine stowage flexibility will also be enhanced with the installation of the universal tie down system in both forward and aft magazines.

[5] The ERGM handling equipment is not installed in any ship, but is an unfunded requirement once ERGM is fielded.

The next major milestone for the Mk 45 program, associated with the development of the extended range guided munition (ERGM), is to incorporate a GPS interface into the gun, which is to be delivered in fall 2004 to the Naval Surface Warfare Center, Dahlgren, VA, for testing. Initial operational capability of the Mk 45 5-inch/62-caliber gun with the GPS interface and ERGM functionality is set for FY06.

Mk 45 Mod 2
5-inch/54-caliber gun



Mk 45 Mod 4
5-inch/62-caliber gun

Gun Computer System (GCS)

Description

The Mk 160 Mod 8 GCS is a modification of the existing Mk 160 Mod 4/6 systems deployed aboard DDG 51 class ships. It supports the introduction of ERGM and improved conventional munition (ICM) rounds, the updated Mk 45 Mod 4 gun mount, and the interfaces with NFCS. Additionally, the Mk 160 Mod 8 GCS provides enhanced human interface via the AN/UYQ-70 display console in the combat information center (CIC). The GCS provides operational controls, track filtering, ballistic computations, gun pointing and stabilization, and ammunition selection and firing orders for ballistic munitions and ERGM. The GCS operates under the control of the Aegis combat system.

Operational Impact

When supporting land attack missions, the GCS responds to the direction of NFCS and can accept and process up to 20 targets at a time. The GCS also receives engagement scheduling and engagement orders for the assigned targets from NFCS. When a specific target is designated for engagement, the GCS Mk 160 Mod 8 computes two fire control solutions, a primary and secondary, depending on the type of projectile to be fired.

Program Status

The Mk 160 Mod 8 GCS for DDGs 81 through 90 and Mk 160 Mod 9 GCS for DDG 91 are being installed with 5-inch/62-caliber gun installations in DDG 51 class ships as noted. Those CG 47 class ships that may be upgraded as part of the cruiser conversion program will receive Mk 160 Mod 11 GCS installations.

Advanced Gun System (AGS)

Description

The 155mm advanced gun system (AGS) is being developed as a conventional, single-barrel, low-signature gun system with fast-reaction, fully stabilized train and elevation capabilities. Targeted to meet demanding requirements for land attack, AGS will operate at a 12-rounds-per-minute firing rate, in both maximum and sustained firing modes. Drawing from a fully automated weapon handling and storage system for up to 600 rounds, AGS will employ a family of guided and ballistic 155mm munitions. By eliminating the need for personnel in the magazine, the AGS design supports Navy goals to significantly reduce overall crew requirements.

AGS is being developed as a complete weapon system through the extensive use of rapid virtual prototyping, with the gun, magazine, ammunition and support subsystems integration all within the responsibility of the design team. AGS armament and system munitions are being concurrently developed for rapid and effective achievement of maximum naval surface fire support range requirements of up to 100nm. The extended range for AGS payloads will be achieved through an optimized balance of gun-launch and projectile rocket motor energies.

The AGS integrated system control, or ISC, combines both gun control and fire control elements within the AGS architecture for integration with the total ship computing environment. AGS design innovations also incorporate advanced thermal and erosion management technologies to ensure extended barrel life and to minimize infrared signature.

Operational Impact

The AGS will provide flexible, sustainable and affordable firepower against a wide range of littoral and inland targets as well as highly advanced gunfire capabilities for anti-surface warfare.

Program Status

The AGS is being developed for the DD(X). The first AGS will be delivered to the shipyard in FY08 to support lead ship delivery in FY10.

155mm Advanced Gun System Mockup

COMMAND, CONTROL, AND COMMUNICATIONS SYSTEMS

Naval Fires Control System (NFCS)

Description

The naval fires control system (NFCS) is a shipboard naval fires planning and coordination system designed to automate all shipboard fire-support battle management duties. NFCS will be installed aboard all surface combatants receiving 5-inch/62-caliber gun installations. It provides an interface to AFATDS, the GWS, and forward entry devices (i.e., TLDHS/DACT).

Operational Impact

NFCS provides the surface combatant a digital link through various systems interfaces to the automated fires support network used by the maneuver forces ashore. The introduction of NFCS reduces the number of personnel required to perform NSFS functions. The configuration of NFCS and ATWCS/TTWCS further reduces the number of personnel by allocating NSFS responsibilities to the strike watch team positions. NFCS also provides land attack situational awareness by accessing and presenting the tactical picture of the area of operations received from GCCS-M and AFATDS.

Program Status

NFCS is programmed for installation in DDGs 81 through 113.

Combined GCCS-M/NFCS Shipboard Installation

ADVANCED FIELD ARTILLERY TACTICAL DATA SYSTEM (AFATDS)

Description

AFATDS is a multi-service automated fire support command and control system. It provides the capabilities to process, analyze, and exchange combat information within the AFATDS architecture and other C2 systems such as the Army battle command system (ABCS);[6] Marine air ground task forces command, control, communications, computers, and intelligence (MAGTF C4I)[7] system; and the naval fires control system (NFCS). The system is also compatible with the command and control systems used by several NATO nations.

AFATDS is capable of managing field artillery cannons and rockets/missiles, mortars, NSFS, close air support, and Army/Marine Corps aviation (helicopter) attack systems at echelons from Corps (Army)/MEF (Marine Corps) to platoon level. It is a battlefield management and decision support system of mobile, dispersed, multifunctional nodes providing automated planning and execution capabilities to fire support operational facilities (OPFAC)[8] and independent user centers (IUC).[9]

Operational Impact

AFATDS automates the functions and tasks performed by agencies involved in fire support, i.e., fire planning, tactical fire direction, and fire support coordination. It filters, screens, and processes requests for fire support and prioritizes target engagements based on selected factors. These factors include the supported maneuver unit commander's targeting guidance and attack criteria for fire support, target characteristics, target value analysis, weapon systems availability, weapon system capabilities, and Joint Munitions Effectiveness Manual (JMEM) data.

AFATDS ensures that fire missions comply with fire support coordination measures and unit zones of responsibility. It selects and generates an engage/fire order to the optimum weapon system available to engage a target and, based upon target priority, recommends the best attack method for the selected system.

Program Status

AFATDS is being developed and fielded in a multi-version, phased approach. The A98 baseline, with incorporated Marine Corps specific requirements, is currently fielded. The A99 baseline, which incorporates technical fire direction for field artillery guns, rockets, and missiles, is currently being fielded. Additional baselines are planned through FY05.

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[6] ABCS links strategic, operational, and tactical headquarters. ABCS is an umbrella system encompassing the global command and control system-Army (GCCS-A), Force XXI battle command-brigade and below (FBCB2), theater airspace integration system (TAIS), integrated meteorological system (IMETS), digital topographic support system (DTSS), and integrated system control system (ISYSCON).

[7] The MAGTF C4I system will support the operational methods and basic goals and designs for the C4ISR systems architecture. The MAGTF C4I system is based on the fielded communications system, MAGTF C4I tactical software applications, and the supporting hardware configuration.

[8] OPFACs include fire support elements (FSE) (Army) and fire support coordination centers (FSCC) (USMC) at the supported maneuver force, field artillery command posts (FA CP) and fire direction centers (FDC), and FA fire unit command posts.

[9] IUCs are remote terminals that allow commanders and selected fire support personnel to monitor fire support operations and issue guidance and directives from widely dispersed battlefield locations.

AFATDS, as part of the SACC automation program, will be installed in all 12 of the LHD/LHA class amphibious assault ships by the end of 2nd Qtr, FY04. It is planned for installation on the LPD-17 class ships.

AFATDS Shipboard Installation

Data Automated Communications Terminal (DACT)

Description

DACT is a small, lightweight Marine Corps system with various tactical software applications that will allow users to compose, edit, store, and display images and messages that are received or transmitted via several types of tactical communication devices. It is both hand-portable and vehicle-mountable. DACT has an internal hard disk that can run several commercial operating systems. It also has a dual-channel modem port and field communications wire binding posts. Artillery forward observers (FOs), fire support teams, and combat observation and lasing teams will use DACT to pass fire control and support data and information, such as that identified by lightweight laser designator range-finder (LLDR), to request a fire mission. LLDR will feed its data into the DACT running target hand-off system (THS) software, which allows fire support observers to operate within the AFATDS fire support network. DACT also uses command and control for the PC software (C2PC), which integrates it with GCCS for tactical picture data exchange and display. DACT has several expansion options, including voice activation, memory and data processing increases, and a head-mounted display and camera. The voice activation feature allows the observer to call for fires, if desired, rather than "punching in" data.

Operational Impact

DACT will provide situational awareness to and critical command and control information to tactical units below the battalion and squadron levels. Additionally, it will enable FOs to communicate with AFATDS.

Program Status

DACT completed operational testing in FY01. Anticipated procurement was for 1,083 mounted and 1,813 dismounted units by the end of FY02.

Automated Digital Network System (ADNS)

Description

Automated digital network system (ADNS) provides a secure, interoperable, multimedia intelligent network management system for data transfer and ship and shore automated routing and switching of tactical and strategic C4I data. ADNS uses transmission control protocol/internet protocol (TCP/IP) networks linking deployed battle group and amphibious ready group units with each other and with the DISN ashore via multiple radio frequency paths. The ADNS provides timely data delivery service to and from all data user resources. The development of ADNS is based on the incorporation of COTS and GOTS hardware and software.

ADNS comprises three functional elements: integrated network manager, routing and switching, and channel access protocols. ADNS will operate at the Secret High General Service classification. Initially, multiple security levels from unclassified to Top Secret Special Compartmented Information will be enforced by cryptographic separation using the Network Encryption System (NES). In successive builds, the NES will be replaced by the Embedded INFOSEC Product.

Operational Impact

ADNS provides the following improvements:

- Furnishes autonomous, digital, interoperable, joint and secure LAN/WAN management and control for RF assets on demand to Navy deployed personnel aboard ships and at shore sites
- Ensures worldwide RF communications connectivity
- Automates all communications systems; replaces several unique subnetworks with a single integrated network hub
- Provides integrated network management which resolves problems caused by overloading or underutilization of existing communications circuits, yielding a 4X increase in multi-spectrum throughput efficiency over legacy systems
- Applies NDI COTS/GOTS router, switching and packet data technologies enabling reduced life cycle costs

Program Status

ADNS is an existing capability. ADNS is installed or planned for installation on all Navy ships.

Enhanced Position Location Reporting System (EPLRS)

Description

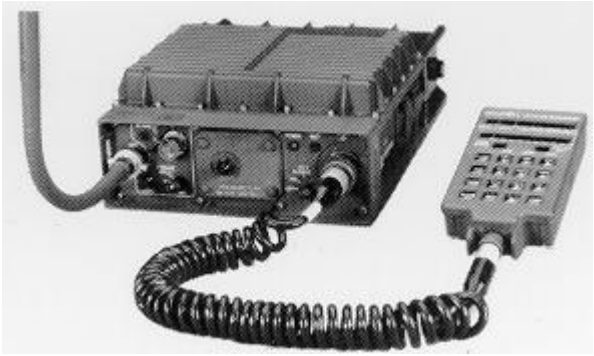
EPLRS is a line-of-sight radio that provides data only (no voice) distribution and position/navigation services in near real-time for forces ashore. EPLRS consists of a network control station and EPLRS user units (EPUUs) that can be configured as a manpack unit, a surface vehicle unit, and an airborne vehicle unit. EPLRS uses time-division, multiple access communications architecture to avoid transmission contention along with frequency hopping, error detection, and correction with interleaving. It also uses spread spectrum technology to provide jamming resistance.

Operational Impact

EPLRS provides automated, secure, near real-time radio communications systems to tactical commanders and their staffs; provide data distribution capability between computers as well as position, location, and navigation reporting of their combat elements in support of tactical operations.

Program Status

EPLRS is currently being fielded. Options are being reviewed to procure additional units by FY04. EPLRS is currently planned for installation onboard LHD/LHA class amphibious ships.



EPLRS User Unit

Global Command and Control System (GCCS)

Description

GCCS is an automated information system designed to support situational awareness and deliberate and crisis planning with the use of an integrated set of analytic tools and flexible data transfer capabilities. The system consists of all necessary hardware, software, procedures, standards and interfaces for connectivity worldwide to combatant commanders, the services, and defense agencies.

GCCS interfaces with a sensor and communications infrastructure to provide source data and to access key information databases, and to maintain communications between GCCS sites. This infrastructure provides data distribution mechanisms needed to share data among GCCS locations over a wide area network (WAN) providing a common view of the battlespace.

Information used to support the common operational picture (COP) is passed through this system. The COP supports commanders in planning and conducting joint operations. The purpose of the COP is to gather information from various sources into one concise graphical format and into an integrated data environment for utilization by other systems such as TTWCS and NFCS. The COP provides commanders with an automated battlespace situational awareness tool to assist in the decision making process where COP includes both theater-wide and local data such as the ground picture that is provided by USMC GCCS and Army GCCS-A infrastructure.

Operational Impact

With GCCS, joint commanders can coordinate widely dispersed units, receive accurate feedback, and execute more demanding, higher precision requirements in fast moving operations. Commanders can better synchronize the actions of air, land, sea, space, and special operations forces. The GCCS provides the combatant commands and joint force commanders (JFCs) with the ability to provide military information rapidly to the national leadership and supporting commands.

Program Status

GCCS is a current capability. The afloat version of GCCS, GCCS-Maritime (GCCS-M), is currently installed in all Navy ships, tactical support centers, and shore command sites.

Combined GCCS-M/NFCS Shipboard Installation

High Frequency (HF) Communications Systems

Description

The high frequency radio group (HFRG) operates in the very low frequency (VLF), low frequency (LF), medium frequency (MF), and high frequency (HF) bands and supports full duplex, half duplex, and simplex operation for tactical and long-haul voice, interrupted continuous-wave, teletype, and digital data communications in the lower sideband (LSB), upper sideband (USB), independent sideband (ISB), amplitude modulation equivalent (AME) and Link 11 modes of operation. The HFRG provides tunable communications in the 2–30 MHz frequency range. HF circuits are used in either the voice or data mode, at up to 1200 bps. They are interoperable with the Marine Corps' PRC-104 and GRC-193 legacy HF radios and with the newer PRC-138 radios with automatic link establishment capabilities. These radios operate in the 2-29 MHz band in either the analog voice or analog data mode using frequency shift keying (FSK). FSK operations on DDGs are limited to two HF data channels available on the AN/URA-17G comparative converter. The converter is required for shipboard signal conversion for the HF FSK mode. The HFRG uses the KYV-5 encryption device to support land attack missions, which is interoperable with the KY-99 used in other land attack communications systems.

Operational Impact

High frequency (HF) radio communications have been the traditional means for naval gunfire spotters to control naval fires at beyond line-of-sight ranges. HF provides a secure, long-range path for ground forces to communicate with surface combatants.

Program Status

This is an existing capability. The Navy, however, continues to procure and enhance its HF communications suites, moving toward completely integrated, solid-state communications. The most recent upgrade to the HFRG is the AN/URC-131(V), is installed on all major surface combatants, aircraft carriers, amphibious and command ships.

Navy Extremely High Frequency (EHF) SATCOM Program (NESP)

Description

The Navy extremely high frequency SATCOM program (NESP) has a 44.5 Gigahertz (GHz) up-link and a 20.7 GHz down-link capability that provide a joint interoperable low data rate (LDR) and future medium/high data rate (MDR/HDR) connectivity for ships and shore stations. Enhancements ear-marked for the AN/USC-38 (V) EHF terminals will provide transmission control protocol/internet protocol (TCP/IP) communications to support battle group inter-ship and ship-to-shore data exchange requirements, including fire support information. Marine Corps and Army units equipped with the EHF secure mobile anti-jam reliable tactical-terminal (SMART-T)[10] can participate with Navy units in an LDR network.

Operational Impact

EHF SATCOM provides jointly interoperable low data rate and future medium and high data rate anti-jam, low probability of intercept/detection connectivity for submarines, surface combatants and forces ashore.

Program Status

This is an existing fleet capability. Currently, EHF has been installed or funded for CG 52 through 73, DDG 51, LHA-1, and LHD-1 classes, SSNs, and is planned for the LPD-17 class.

Marine Corps EHF AN/TSC-143 STAR-T

[10] SMART-T is a transportable HMMWV mounted tactical SATCOM terminal that operates with MILSTAR compatible communications payloads.

Joint Tactical Radio System (JTRS)

Description

JTRS is a joint service initiative to acquire a family of affordable, interoperable tactical radios to provide both line-of-sight and beyond-line of sight C4I capabilities to warfighters. JTRS is a family of radios that are interoperable, affordable and scalable. The cornerstone of the JTRS program is the development and deployment of software defined radio (SDR) technology through standardized, open software architecture. Once achieved, waveform interoperability across a variety of radio platforms will be possible. The goal of the JTRS Joint Program Office is to migrate current legacy systems to system complaint with the JTRS architecture.

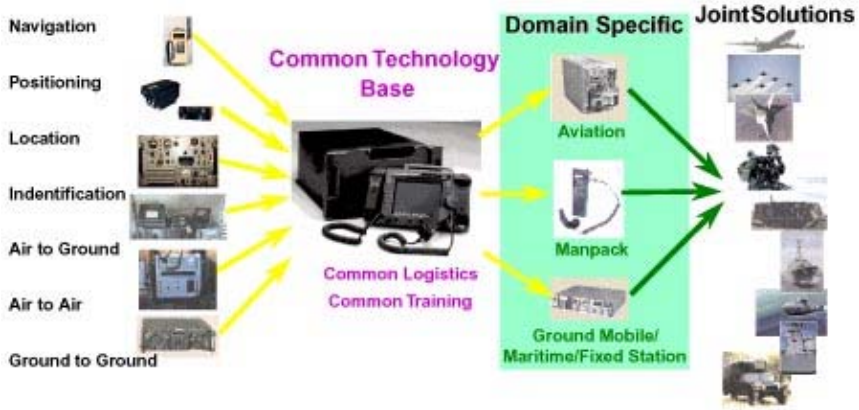
Operational Impact

The JTRS SDR technology will allow interoperability across a wide variety of radios. When implemented, the JTRS program will allow or provide:

- Common open architecture
- Multiple domain support
- Multiple-band, multiple mode usage
- Compatibility with legacy systems
- Enable technology insertion/refresh
- Enhanced security, including multi-level security
- Support wideband and legacy networking
- Allow software reuse

Program Status

This is a funded program that is under development. A contract was awarded in June 2002 for the development, demonstration, and low rate initial production of Cluster 1 JTRS. Cluster 1 is the first of a number of clusters for the JTRS and consists of U.S. Army, U.S. Air Force tactical air control party (TACP) and U.S. Marine Corps ground radios, as well as Army rotary wing aircraft radios. Early operational assessment testing for JTRS is anticipated during summer 2004. Low-rate initial production is expected to commence in 2005. The low-rate initial production objective is 10,000 vehicular and airborne systems. Future production quantities generated by the Cluster 1 program are expected to exceed 100,000 units.



JTRS Program and Concepts

Mission Distribution System

Description

The Mission Distribution System (MDS) is the command and control element for the TC2S. The MDS provides functions for Tomahawk strike planning and coordination, strike monitoring and control for airborne Block IV missiles, strike reporting, support to operational planning, Tomahawk asset management, and the management and distribution of Tomahawk Command Information (TCI). MDS functions support a range of roles in several organizations, including the Tomahawk Executive Agent (TEA), Tomahawk Strike Coordinator (TSC), strike controller, Launch Area Coordinator (LAC), Theater Tomahawk Database Manager (TTDBM), TCI managers at TMPC and APS locations, and shipboard Tomahawk officers. In addition, MDS installations support Numbered Fleet Commanders, Navy fleet Commanders, and the J-3 staff for some theater Combatant Commanders.

MDS performs the following major functions for tactical and operational decision-making:

- Processing data from tasking and coordination communications such as the Air Tasking Order (ATO) and the Airspace Control Order (ACO);
- Creating and employing airspace coordination measures for Tomahawk operations;
- Planning Tomahawk strikes and issuing strike tasking;
- Performing strike monitoring and control for Block IV missiles;
- Automated communications planning for Block IV missiles using the TSN;
- Providing access to mission information and supporting imagery products;
- Receiving and processing strike execution data for use in post-strike assessment;
- Strike preview, strike rehearsal, and post-strike playback;
- Creation and distribution of pre-strike and post-strike briefings for coordination with other organizations; and
- Display of appropriate sensor contact data from external sources for situational awareness and strike control.

Major MDS functions for automation-assisted TCI management and distribution include:

- Receiving, certifying, maintaining, and distributing Tomahawk mission data, missile flight software versions, OES components, targeting databases, environmental data, airspace coordination information, and mission libraries;
- Maintaining accountability records to track and manage the planning and planning support databases among TC2S nodes;
- Receiving, using, distributing, and managing threat and environmental information used at TC2S locations;
- Receiving, providing access to, and distributing operational and tactical guidance and information;
- Generating, developing, and tracking mission planning requests (MPR) and transmitting them to TPS for mission planning; and
- Planning and executing electronic transfers of mission data and file data to firing units and C2 locations via mission data updates (MDU) and file data updates (FDU).

MDS performs the following automation-assisted functions for Tomahawk asset management:

- Receiving, maintaining, using, and distributing force and unit missile inventory data; and
- Receiving and tracking information about unit capabilities, system status, and latest position information for Tomahawk firing units and C2 locations.

In addition to tactical, operational, and technical information in the organic MDS database, MDS also organizes supporting information in non-native form within a set of directories called “the Planner’s Bookshelf.” The Planner’s Bookshelf provides a structured repository for storing and using information such as the current

or planned ATO, an Attack Guidance Matrix from a supported ground commander, target lists or spreadsheets, extracts from operational plans and orders, OPTASK messages, and so forth.

Operational Impact

MDS provides the capability to plan and execute operations by a task organization of C2 agents and firing units, and enables improved flexibility, responsiveness, and lethality in the TWS. The networked Tomahawk force can redirect airborne Tactical Tomahawk missiles from any MDS location designated as the strike controller, and all other MDS locations can monitor and track the strike. MDS provides improved joint force interoperability with joint air operations and joint fires, and supports joint force integration between Tomahawk and the commanders it supports, including for agents in other components.

Program Status

MDS is a deployed capability, with MDS version 4.1 delivered to all CMSAs, APS, C2 nodes, and Tomahawk-capable surface ships. MDS 4.1 replaced the ETEPP software and its UNIX workstation with a PC using the Windows OS and applications. Future MDS deliveries provide expanded capabilities in the same computer and an upgraded MDS application. The next delivery, anticipated for January 2003, provides MDS 4.2.1, which supports TMPC 3.3 and TTWCS Phase A (Block III capabilities only). The IOC for TWS Baseline IV, scheduled for 2004, brings the next version of MDS, and that delivery supports all IOC capabilities for TWS Baseline IV. The final delivery is a post-IOC build that will provide the complete span of Baseline IV enhancements.

Single Channel Ground and Airborne Radio System (SINCGARS)

Description

SINCGARS, the standard radio for all U.S. ground forces, is a family of very high frequency (VHF)/FM radios that features high resistance to surveillance, interception, and jamming. Eight single channels and six frequency-hopping preset channels are available in the 30–88 MHz band. The internal communication security modules are compatible with the KY-57/TSEC communication devices. The radio contains an internal data modem that supports a variety of digital terminals. Use of the AN/ASC-26 airborne radio relays can extend the range of the SINCGARS data networks beyond the horizon.

Operational Impact

Technological improvements in enemy jamming and electronic collection and exploitation seriously challenge the effectiveness of friendly tactical communications. With SINCGARS-operative radios, the capabilities of sophisticated, complex enemy jammers have to a great extent been neutralized. The surface combatant's SINCGARS 21 VHF radio provides both voice and data connectivity to amphibious ships and to maneuver force fire support elements ashore.

Program Status

SINCGARS is installed on amphibious ships and is being installed on all surface combatants that have NFCS.

SINCGARS Radio

Tactical Control Station (TCS)

Description

The TCS is a software-focused program that provides the warfighter with a scalable and modular capability to operate UAVs on existing computer systems and interface with current and future command, control, communications, computers, and intelligence (C4I) systems to disseminate UAV sensor products. It provides mission planning, as well as platform and sensor control, of tactical unmanned aerial vehicles (TUAV), medium altitude endurance (MAE) unmanned aerial vehicles (UAVs), and potential future vertical takeoff and landing UAVs (VTUAV) stationed on surface combatants.

The TCS capability onboard a ship will range from receipt and transmission of secondary imagery and data to full control of the UAV from take-off to landing. It may also be able to control and/or receive sensor data from non-organic UAV assets once the organic VTUAV capability is established. It will be able to hand off control of a ship launched VTUAV to a land-based unit.

Operational Impact

TCS capability enables commanders to fully integrate and synchronize UAV control and sensor product distribution to achieve unity of effort in joint operations.

Program Status

This program is currently unfunded in the Navy, however, the Navy may install TCS aboard the SCFoS and legacy ships that may be provided a UAV capability in the future. The Marine Corps and Army may have mobile and land-based configurations.

Tomahawk Command and Control Segment (TC2S)

Description

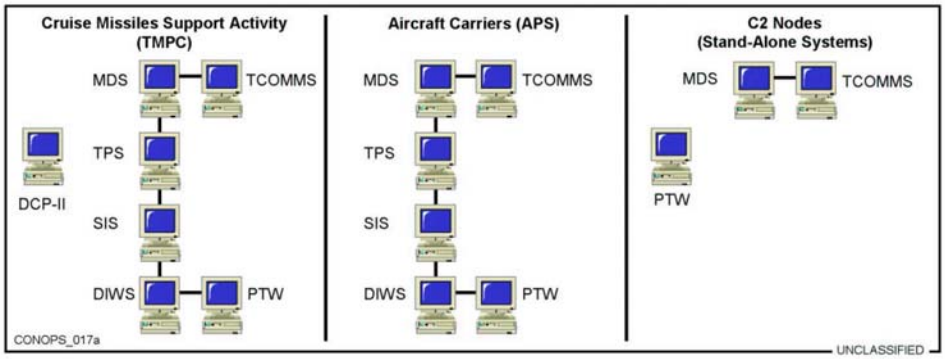
The TC2S includes the following subsystems: the Tomahawk planning system (TPS), the security isolation segment (SIS), the digital imagery workstation suite ((DIWS), the mission distribution system (MDS), the precision targeting workstation (PTW), the Tomahawk communication system (TCOMMS), the mission validation system (MVS), and the data transfer media (DTM) certification processor (DCP-II).

Operational Impact

The TC2S provides a secure environment for communications, mission generation (storage, retrieval, and update), strike package processing (planning and coordination), strike execution, monitoring, control, and reporting.

Program Status

This is an existing capability installed at all cruise missile support activities (CMSA), in all APS-equipped ships, and at COMFIFTHFLT. A more limited configuration is installed onboard Tomahawk firing units.



INTELLIGENCE, SURVEILLANCE, AND TARGET ACQUISITION

Target Location Designation and Handoff System (TLDHS)

Description

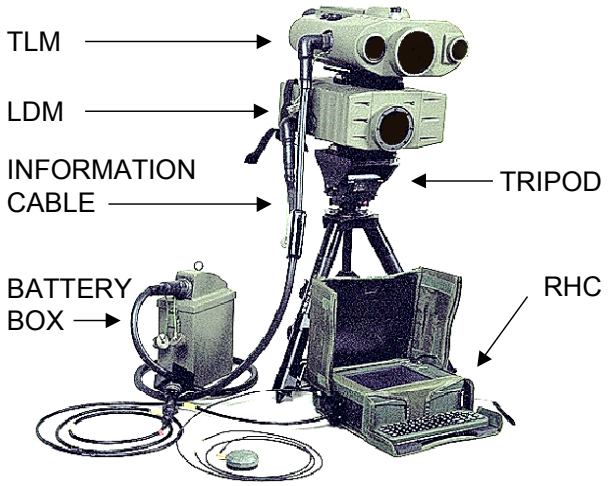
TLDHS is a Marine Corps, man-portable, automated, equipment suite that will give forward observers, forward air controllers (FACs), naval gunfire spot teams, and reconnaissance teams the ability to quickly locate, acquire, and designate targets. Observers can then digitally transmit (hand-off) target data to fire support coordination and direction agencies or weapon delivery platforms. TLDHS includes two major subsystems, the LLDR and the target hand-off system (THS). THS is a man-portable system that includes an embedded precise positioning service GPS receiver, graphical user interface, digital map display, and dual modem interface to tactical communications equipment. The rugged hand-held computer with THS software will receive, store, create, modify, transmit, and display map overlays, operational messages and reports, and position information via tactical radios, networks, and wire lines.

Operational Impact

The LLDR will identify, locate, and designate the target while the THS provides the pre-formatted messages and tactical communications system to digitally enter the mission into the fire support command and control system. THS will replace the digital communications terminal (DCT) and will serve as the Marine Corps primary data entry system for AFATDS.

Program Status

IOC is projected for 3rd Quarter FY03 with a FOC of 3rd Quarter FY06.



Target Location Designation and Handoff System (TLDHS)

Lightweight Laser Designator Range-finder (LLDR)

Description

The LLDR, is a modular, man-portable system that will provide ground forces with precision target location and designation. LLDR is a joint Army/Marine Corps development that will serve as the laser range-finder/designator system for both services. The target location module (TLM) of LLDR includes day optics, a thermal imager, an eye-safe, laser range-finder, a digital electronic compass and vertical angle measurement, a battery, a microprocessor, an operator interface and display, and data/image export capabilities, all functioning to determine the range and direction to a target.

Target and observer locations are calculated using either an embedded GPS receiver or an electronic interface with a precision lightweight GPS receiver (PLGR). The TLM will provide target location accuracy to 80 meters circular error probable (CEP) out to 9,995 meters. The embedded GPS unit calculates target data by integrating the laser rangefinder's slant range to the target, the electronic compass' azimuth and vertical angle to the target, and the known location of the observer. The target data is passed digitally to fire support coordination and direction agencies or weapon delivery platforms via tactical communications equipment such as the RHC.

Operational Impact

The LLDR will provide ground forces with the capability to detect, recognize, locate, and designate targets and then to send digital self/target data directly to land attack fire control centers. This capability is a significant improvement in terms of accuracy and responsiveness over previous systems. LLDR also supports reconnaissance, surveillance, and target acquisition requirements for munitions such as SADARM, ERGM, JDAM, and JSOW.

Program Status

The LLDR completed Milestone III late FY01. Fielding for the Marine Corps is expected in FY04.

Naval Fires Network (NFN)

Description

Operations DESERT STORM and ALLIED FORCE identified a critical operational deficiency in time sensitive targeting (TST) against rapidly relocatable targets. Since the 1990s, this threat—including the potential delivery of weapons of mass destruction—has increased.

Naval fires network (NFN) is a transformational architecture that addresses this critical deficiency by providing near real time intelligence correlation, sensor control, target generation and development, mission planning, interfaces to engagement systems, and battle damage assessment capability. IT will provide the capability to detect, identify and localize targets with precision sufficient for TLAM or other precision weapons. NFN is realized by interfacing, and ultimately integrating, elements of three existing systems into a converged architecture: joint service imagery processing system-Navy (JSIPS-N), tactical exploitation system-Navy (TES-N), and global command and control system-Maritime (GCCS-M).

NFN requires communication links capable of rapidly receiving ISR data from multiple tactical and national sources. Direct access to in-theater tactical imagery and SIGINT data from multi-service airborne collectors requires the common data link-Navy (CDL-N) capability aboard the afloat platform. CDL-N is a DoD mandated interoperable, point-to-point, high bandwidth (up to 275 Mbps), secure data link for microwave downlink and onboard processing of ISR data from tactical collectors.

NFN can be employed as a stand-alone system or as a server supporting multiple remote terminal component (RTC) clients. RTCs have a smaller equipment footprint and cost less than full systems, allowing installation aboard space constrained platforms such as surface combatants and submarines. The RTC configuration does not normally include CDL-N, so RTC units are dependent on full NFN systems to forward real-time downlink of theater and tactical ISR information. Robust information exchange between NFN servers and RTC clients will require an upgrade in the fleet's satellite communications capabilities. The near-term communications architecture will use a combination of SATCOM solutions, including SHF Defense Satellite Communications Service (DSCS) X-band and EHF MDR (medium data rate), augmented by Challenge Athena.[11] CDL-N is currently installed on 10 aircraft carriers, one LHD and one command ship, and is programmed for installation on all large-deck amphibious ships.

Operational Impact

NFN component systems enable rapid execution of the joint targeting cycle. NFN is intended to counter the full range of land-based and afloat TSTs. A subset of TST is the time critical target (TCT) set including rapidly relocatable targets of particular interest due to their ability to carry weapons of mass destruction payloads. Recent events underscore the reality of a terrorist threat and highlight the need for real-time intelligence and situational awareness tools employable for both homeland defense and overseas operations.

Program Status

Following the events of 9/11, Navy received emergency supplemental funding to rapidly deploy NFN capability—TES-N installations and JSIPS-N, GCCS-M and communications upgrades. In parallel

[11] The Challenge Athena program leverages commercial wideband SHF SATCOM capabilities to provide deployed Navy units with high data rate communications transmission and dissemination of national imagery and other information.

with executing these wartime operational deployments, the NFN Program Office is developing plans to continue spiral development and acquisition of the NFN architecture. NFN capability will be installed on command ships, select aircraft carriers and the shore-based LSS will be upgraded to a NFN level of capability. All other aircraft carriers and amphibious command ships will receive a RTC installation.

AN/TPQ-37 FIREFINDER

Description

The U.S. Army AN/TPQ-37 FIREFINDER is a medium-range weapons-locating radar system that quickly detects and pinpoints the location of adversary long-range weapons. It can locate up to 10 different weapons in seconds to a maximum range of 50 km. A special 60-degree sector mode can extend the range to locate high interest targets such as tactical ballistic missiles. It also corrects and improves the delivery of friendly fire. The AN/TPQ-37 is usually deployed in general support of divisional artillery or in direct support of multiple launch rocket system battalions.

The AN/TPQ-37 system uses the standard 5-ton medium tactical vehicle for its prime mover. It can be transported in a single C-130 sortie. An eight-person crew can accomplish rapid emplacement and displacement.

Effective Detection Ranges:

Mortars	15 km
Artillery:	30 km
Rockets:	50 km

Operational Impact

The AN/TPQ-37 automatically detects and backplots enemy projectiles and provides accurate targeting data for counterfire. The AN/TPQ-37 is optimized for locating long-range mortar, artillery and rocket projectiles out to 50 km. The U.S. Army combines the AN/TPQ-37 with the AN/TPQ-36 to field an accurate, effective and mobile firefinder system.

Program Status

The AN/TPQ-37 is a fielded system.

AN/TPQ-37 FIREFINDER Radar

AN/TPQ-47 FIREFINDER BLOCK II

Description

The U.S. Army AN/TPQ-47 FIREFINDER Block II is a long-range weapons-locating radar system. It will provide an upgrade and eventually replace the existing AN/TPQ-37. The new radar will provide a more survivable, longer-range radar that requires less manpower to transport, set up and maintain. It will also provide rapid and increased target location accuracy and target classification at greater ranges. The upgrade integrates with AFATDS to ensure rapid counterfire.

The AN/TPQ-47 system will use the standard 2.5-ton light/medium tactical vehicle for its prime mover. It can be transported in a single C-130 sortie or by CH-47 helicopter lift. A six-person crew can accomplish rapid emplacement and displacement in approximately 15 minutes.

Effective Detection Ranges:

Mortars:	30 km
Artillery:	60 km
Rockets:	100 km
Missiles:	300 km

Operational Impact

In comparison to the AN/TPQ-37, the AN/TPQ-47 will improve system transportability, maintainability and reliability for increased effectiveness on the battlefield. It will also double the current range performance for detecting incoming fire from mortar, artillery and rockets and will detect tactical ballistic missiles out to 300 km.

Program Status

The AN/TPQ-47 will begin developmental testing in FY03. Low rate initial production is expected in FY04.

AN/TPQ-47 FIREFINDER Block II Radar

AN/TPQ-36 (AN/TPQ-46A USMC)

Description

The AN/TPQ-36 FIREFINDER V(8) (AN/TPQ-46A Marine Corps nomenclature) is a short-range weapons-locating radar system that is deployable on high mobility multipurpose wheeled vehicles (HMMWVs). AN/TPQ-36 V(8) uses the lightweight computer unit (LCU) to process targets and transmit them to the counterfire-coordinating unit via SINCGARS. The LCU provides the capability to communicate directly with AFATDS that will select the weapon system for the counterfire mission. The weapon system selected could be sea-based. Fielding of the V(8) began in 1999.

Operational Impact

In comparison to older versions,[12] the AN/TPQ-36 V(8) has increased range capabilities, a faster and larger target data throughput capability, and improved discrimination capabilities to identify the type of incoming projectile. It is optimized to locate short-range, high-angle weapons such as mortars. However, it can also locate artillery and rockets. Simultaneous fires from more than one location can be processed. Enemy firing positions can be located from the first round fired. Dependent on the terrain, it can effectively detect artillery and finned mortar projectiles (81mm and larger) out to ranges of 12,000 meters, and rockets out to ranges of 24,000 meters with an accuracy of 40 to 100 meters.

Program Status

The AN/TPQ-36 V(8) is a current capability. Twenty-two systems have been funded for the Marine Corps. Fielding of the AN/TPQ-36 V(8) will be completed by 2005.

Marine Corps AN/TPQ-36 V(8)

[12] AN/TPQ-36 V(5) Army and Marine Corps; AN/TPQ-36 V(7) Army and AN/TPQ-46 Marine Corps.

AN/SPY-1 Radar System

Description

The AN/SPY-1 radar system is the primary air and surface radar for the Aegis combat system installed in the Ticonderoga (CG 47) and Arleigh Burke (DDG 51) class surface combatants. It is a multi-function, phased-array radar capable of search, automatic detection, transition to track, tracking of air and surface targets, and missile engagement support. The radar's four fixed arrays send out beams of electromagnetic energy in all directions simultaneously, continuously providing a search and tracking capability for hundreds of targets at the same time and initial detection to first missile movement is less than 10 seconds. The third variant of this radar, AN/SPY-1D(V), known as the littoral warfare radar, will improve the radar's capability against low-altitude, reduced radar cross-section targets in heavy clutter environments and in the presence of intense electronic countermeasures. The radar has also demonstrated a capability to detect and track theater ballistic missiles.

Operational Impact

The AN/SPY-1 provides surface combatants with situational awareness and fast reaction to threats. It will enable the surface combatant to search, automatically detect threats and targets, track air and surface targets, and will provide missile engagement support. Modifications to the AN/SPY-1 radar software may provide surface combatants with counterfire capabilities.

Program Status

As part of their naval surface fire support requirements, the Marine Corps has requested that the Navy explore modifications to the AN/SPY-1 radar software to provide a real-time, sea-based counterfire capability. This capability would allow SPY to detect, track, and then back track enemy projectiles, thus locating enemy firing units for counterfire and counterbattery responses. During an April 1999 at-sea test, the SPY-1 radar demonstrated the potential for locating counterfire sources within the radar horizon.

In September 1999, COMNAVFOR Korea initiated a Mission Need Statement for a naval counterfire sensor capability. This has been endorsed by the COMSEVENTH Fleet and Commander in Chief, U.S. Pacific Fleet, and is being staffed and researched by the surface warfare requirements staff.

SPY-1 Radar Installation Onboard Arleigh Burke Class Destroyer

SPY-1 Radar Installation Onboard Ticonderoga Class Cruiser USS San Jacinto

Electro-Optical Sight System (EOSS)

Description

As a component of the Mk 34 Gun Weapon System, the Mk 46 Mod 0 EOSS incorporates two primary sensors, a daylight imaging sensor (DIS) which operates in the visible spectrum and a thermal imaging sensor (TIS), a forward looking infrared (FLIR) device. The Mk 46 is operated from a dedicated console in CIC where the operator may select either DIS or TIS for an operation or event. The selected sensor provides video to the operator at his console and to remote displays. EOSS is interfaced, and may be slaved, to GCS. The EOSS Mod 1 will incorporate a laser range finder sub-system that can support a potential look-point-shoot capability. EOSS is integrated into the ship's fire control system.

Operational Impact

The Mk 46 Mod 0 EOSS can provide an organic detection, identification, target localization, and battle damage assessment capability for targets within line of sight. It can also assist with various ship control functions such as channel navigation, surface target surveillance, and aspect determination, especially during periods of restrictive emission control.

Program Status

The Mk 46 Mod 0 EOSS is currently installed onboard DDG 51 class combatants as well as the USS Yorktown (CG 48).

Mk 46 Mod 0 EOSS Pedestal Mount

Mk 46 Mod 0 EOSS Operating Console

SUPPORTING SYSTEMS

Global Positioning System (GPS)

Description

The GPS is a DoD developed, worldwide, satellite-based radio-navigation system that provides a highly accurate military positioning, velocity and timing service available on a continuous, world-wide basis to authorized users. It consists of three segments: a space segment, a ground segment, and a user segment. The space segment contains a constellation of 28 satellites that provide nearly global coverage. The ground segment provides the control stations for managing the satellites and their broadcasts. The user segment is composed of GPS receivers, which can obtain a reliable position location, whenever the receiver can read the signals from at least three satellites. Military GPS receivers are capable of providing a position location with an accuracy of 15 meters or better under most conditions.

Surface combatants are typically equipped with two GPS receivers. The ERGM and Tomahawk are also equipped with GPS receivers for in-flight navigation.

Operational Impact

GPS maintains a common reference for positioning, navigation, and time, thus promoting interoperability among forces and directly improving the efficiency and effectiveness of joint and combined operations. GPS will also aid in all aspects of military combat operations from designation of precise target coordinates to accurately deliver conventional munitions under any conditions of target visibility (e.g., night, clouds, smoke, dust).

Program Status

GPS is an existing capability. GPS modernization is underway for 12 block IIR satellites. These satellites will be modified to incorporate two new military signals and a second civil signal. In addition to the signals, the modifications will also include increased signal power and the ability to reprogram signals and power in orbit, thus improving accuracy and resistance to jamming.

GPS Block IIR Artist's Concept

Computer Aided Dead Reckoning Tracer (CADRT)

Description

The computer aided dead reckoning tracer (CADRT) provides the capability to build and maintain a real-time, fused, tactical picture for watch standers in the combat information center (CIC). The CADRT will replace manual dead reckoning tracer (DRT) plotting functionality with a graphically oriented, geographically based computer system. CADRT will support contact management and situational awareness for antisubmarine warfare (ASW); surface warfare; chemical, biological, and radiological (CBR) defense; search and rescue; mine warfare; NSFS; and expeditionary warfare. The CADRT software architecture is based on the defense information infrastructure common operating environment.

CADRT develops the fused tactical picture with layers of information. The bottom most layers are land and ocean charts. Sensor coverage and intelligence form the next layers. These layers are then combined with tactical decision-aid graphics and sensor measurements to complete the picture. CADRT tactical decision aids are different from most systems in that they are global (displayed immediately to all operators) and update dynamically rather than requiring operator intervention.

Operational Impact

Starting with DDG 85, the computer aided dead reckoning tracer (CADRT) will automate all functions, including the conventional gun target plotting actions, currently performed manually at the horizontal plotting table. CADRT allows simultaneous multi-warfare missions to be performed with greater effectiveness. CADRT also provides a means to plot planned and actual ship movements during tactical operations using digital nautical charts. NSFS specific capabilities include an elevation profile, a call for fire dialog window, and a geographic plot of the NSFS picture. CADRT provides an alternative in the event of an NFCS casualty.

Program Status

CADRT is funded for installation on 42 surface combatants.

CADRT Console

Navigation Sensor System Interface (NAVSSI)

Description

The NAVSSI system collects, integrates, processes, and distributes navigation data to weapons, combat support command, control, computers, communications, intelligence, surveillance, reconnaissance, and other information systems. NAVSSI is comprised of three subsystems: a real time subsystem (RTS), a display-control subsystem (DCS), and a NAVSSI remote station (NRS). The RTS accepts navigation data, determines the best data provided, and distributes the information determined to be the most accurate to other ship's systems. The DCS provides the defense information infrastructure common operation environment compliant user interface for navigation planning, sensor monitoring/selection, mission planning, and processing/distribution of NIMA's digital navigation charts. The NRS extends DCS capabilities to the bridge and provides a navigation display for the bridge navigation team. The NAVSSI is integrated as the navigation node for the global command and control system-Maritime (GCCS-M).

Operational Impact

The NAVSSI provides precise navigation and time data, such as ship's attitude and position to various land attack systems to improve targeting and weapons delivery accuracy.

Program Status

Navy ship classes presently scheduled to receive NAVSSI are AGF, AOE, CG 47, CV, CVN, DD-963, DDG 51, LCC, LHA/LHD, LPD, and LSD.

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APPENDIX C—LAND ATTACK AGENCIES

This chapter discusses agencies that may interface with surface combatants during the execution of land attack missions.

The operational commander must be able to plan, allocate, control, and coordinate fires from all available joint systems. The surface combatant's new land attack capabilities need to be interoperable with joint command, control, communications, computers, intelligence, surveillance, reconnaissance, and targeting (C4ISRT) networks in order to support these operational commanders.

JOINT AGENCIES/SYSTEMS

Joint Targeting Coordination Board (JTCB)

The JTCB is an administrative body that may be formed by the joint force commander (JFC)[1] to accomplish broad targeting oversight functions that include coordinating targeting information, providing targeting guidance and priorities, and preparing and refining joint target lists. The board is normally comprised of representatives from the joint force staff, component commands, and component subordinate units. The output from the JTCB forms the basis for the JFC's apportionment decision. In lieu of forming a JTCB, the JFC may choose to delegate this responsibility to a subordinate commander.

Joint Fires Element (JFE)

The JFC may approve the formation of a JFE within the operations directorate (J-3). This is an optional staff element that provides recommendations to the J-3 to accomplish fires planning and coordination. The JFE assists the J-3 to accomplish responsibilities and tasks as a staff advisor to the JFC to include:

- Develop estimates of the situation and courses of action;
- Develop mission-type orders and guidance for JFC approval;
- Develop operation orders (OPORDs) and operation plans (OPLANs);
- Coordinate combat assessment efforts by the joint force;
- Coordinate rules of engagement (ROE);
- Conduct assessments of the campaign or major operation;
- Recommend, coordinate, review, designate, and disseminate fire support coordinating measures (FSCMs);
- Maintain munitions supply status and logistic concerns; and
- Coordinate with the intelligence division to ensure that the commander's priority intelligence requirements to support targeting are fully integrated into the intelligence collection plan.

[1] The joint force commander: A general term applied to a combatant commander, subunified commander, or joint task force commander authorized to exercise combatant command (command authority) or operational control over a joint force.

Joint Force Air Component Commander (JFACC)

Operational level relationships, policies, and procedures provide the principles and options for command and control of joint air operations through the designation of a JFACC.[2] The authority and command relationships of the JFACC are established by the JFC. These include exercising operational control over assigned and attached forces and tactical control over other military capabilities/forces made available for tasking. The responsibilities of the JFACC include planning, coordinating, allocating, and tasking joint air operations based on the JFC's concept of operations and air apportionment decision. Because of the integrated relationship between air operations, airspace control and air defense operations, airspace control authority (ACA), and area air defense commander (AADC) duties normally are performed by the JFACC.

The organization that supports the JFACC is the joint air operations center (JAOC). The JAOC is divided into a planning section that focuses on development of the air tasking order (ATO) for future operations, and an operations section for executing the current ATO.

The ACA is assigned by the JFC to develop policies and procedures for conducting airspace control within the JFC's area of operation. Procedures are promulgated in the airspace control plan and include instructions for coordinating and deconflicting user requirements, including air and fires assets.

During maritime operations, such as amphibious operations, the ACA may designate the maritime commander as the control authority for a specific airspace control area or sector. The level of control allocated by the ACA to the amphibious force depends on whether or not an amphibious objective area (AOA) is established for an operation. If an AOA is established, the commander designated in the initiating order (usually the CATF) is responsible for airspace control, defense of friendly forces, and direction and deconfliction of supporting arms within the AOA. If an AOA is not established, the amphibious force may request that the ACA establish a high-density air control zone[3] (HIDACZ) in the area of operations (AO).

NAVAL AGENCIES/SYSTEMS

Tomahawk Afloat/Ashore Planning Centers

To support the level of detail required to plan the route and flight profile for TLAM missions from the first preplanned waypoint to the target, the Navy uses cruise missile support activities (CMSAs) and afloat planning system (APS) detachments. APS detachments will be transitioning to strike planning cells in 2004. These agencies provide the expertise and equipment necessary to fully employ the unique capabilities of Tomahawk to support the combatant or joint force commander.

[2] The JFACC responsibility is normally assigned to the component commander (Air Force, Navy, or Marine Corps) with the preponderance of air assets and the capability to plan, task and control joint air operations as per Joint Pub 3-56.1.

[3] A HIDACZ is airspace designated in an airspace control plan or airspace control order in which there is a concentrated employment of varied weapons and airspace users. When employed in amphibious operations, access to the HIDACZ is normally controlled by the naval airspace control agency; e.g., tactical air control/command center (TACC).

Cruise Missile Support Activities (CMSAs)

Cruise Missile Support Activities (CMSAs) plan the routing and flight profile for Tomahawk land attack missile (TLAM) missions from the first preplanned waypoint to the target. CMSAs are a part of the combatant commander's staff and develop plans for targets within the commander's theater of operations. There are three CMSAs capable of planning missions: one at USPACOM headquarters in Hawaii, one at USJFCOM headquarters in Virginia, and one in the United Kingdom. Other combatant commanders are supported by the CMSAs.

The CMSA uses the equipment and computer programs of its theater mission planning center (TMPC) to plan, prepare, and distribute the missions and associated command and control information needed to employ TLAMs. Missions and associated command and control data may be transmitted via mission data update (MDU) or transferred via one of several types of data transport devices. The TMPC is configured in three segments: the Tomahawk planning system (TPS), the digital imagery workstation suite (DIWS), and the mission distribution system (MDS). All equipment is located in a special compartmented information facility (SCIF) because of the classification of data processed in the DIWS. The TPS, DIWS, and MDS all have stand-alone capabilities and can function independently should a system failure occur to any of the segments. While the classified local area network (LAN) is a critical interface between segments, the ability to pass data via magnetic media provides a backup capability.

The TPS segment controls the work flow of the TMPC, prepares and maintains the planning databases, generates TLAM missions in response to tasking, and performs detailed independent quality verification checks (IQVC) on selected missions.

The DIWS segment provides the image management and mensuration needed to exploit imagery in support of the CMSA and afloat planning system (APS) mission. Specifically, DIWS generates imagery-based products to support TLAM route planning as tasked by the TPS. It provides automatic and interactive exploitation of both monoscopic and stereoscopic imagery from a wide range of sensors. The DIWS receives imagery from sources external to the CMSA and APS, screens and catalogs image support data for the TPS, and manages the active imagery files used to accomplish a set of DIWS tasks. The DIWS high-performance workstations permit the operators to display, measure, correlate, control, manipulate, and enhance images. It includes functions for product collection and output and for graphics processing, including viewing stereo displays on a single screen.

The MDS serves as an external link between the TMPC and the operating forces, providing command information and data on data transport devices to Tomahawk weapon control system (TWCS) equipped surface ships and submarines. Advanced Tomahawk weapon control system (ATWCS) vessels receive media via transfer tape or Tomahawk command information distribution order tape. MDS also provides the capability to electronically add mission data to deployed conventional TLAM mission databases, and provides accountability, command and control information, strike support decision aids, and mission descriptive information to designated commanders.

Afloat Planning Systems (APS)

Afloat planning systems have the ability to plan TLAM missions end-to-end, as would a CMSA, but on a much more limited basis. They also generate new missions by modification of ones existing in their master mission library. APS is designed to provide the battle force/battlegroup commander operational flexibility in generating relatively few numbers of missions quickly as a rapid response to emerging targets. APS suites are installed on all aircraft carriers and an APS suite is installed at COMFIFTHFLT. The APS suite has the same functional TMPC configuration as the CMSA, using a smaller set of equipment ruggedized for at-sea use. APS detachments will transition to strike planning cells by 2004. It is envisioned that strike planning cells will address all aspects of conducting naval fires.

TLAM Strike Coordinator (TSC)

The TSC is the designated agent who is responsible for all TLAM strike planning, coordination, and reporting in a strike or series of strikes. In a joint forces operation the TSC effects liaison with the JFACC, naval component commander (NCC), battlegroup commanders, and subordinate warfare commanders to ensure that TLAM is integrated into daily operations. In a contingency operation, the TSC carries out the strike guidance provided in the combatant commander's alert and execute orders. The TSC is designated by the NCC or Tomahawk executive agent (TEA) to perform TLAM strike planning and coordination functions for the NCC or a designated subordinate commander. Among other responsibilities, the TSC coordinates Tomahawk operations with other commanders and coordinators.

The TSC will assume additional duties with the deployment of TACTOM. TSC will become the primary strike monitor receiving and tracking all position, health and status messages from in-flight missiles. He will also manage any retargeting requirements for missiles en route targets that are not specifically assigned to their respective launch platforms for control. TSC will perform all missile communications planning and coordination as part of the strike planning process. The TSC is usually the NCC or the battleforce/battlegroup commander.

Tomahawk Launch Area Coordinator (LAC)

The LAC is the TSC's principal deputy, responsible for leading the execution of TLAM strike operations. The LAC should understand Tomahawk weapon system capabilities and limitations and be knowledgeable of battlegroup TLAM assets and missions. A LAC should always be designated to coordinate on-scene requirements. When launch baskets[4] are separated by large distances, a LAC is normally assigned for each geographic area. The LAC is usually the battle force or battlegroup commander, Destroyer Squadron Commander or the senior CO of the Tomahawk firing ships.

[4] The launch basket is a geographic area from which a Tomahawk is launched to meet mission requirements.

Table C-1 lists functions of the various agencies involved in Tomahawk mission planning and execution and the current command levels in a joint environment.

Table C-1. Tomahawk Campaign Control Responsibilities

Title	Function(s)	Command
Joint Targeting Steering Group	Strategic Target List Apportionment Guidance	Combatant Commander Staff Element
Joint Targeting Coordination Board	Joint Integrated Target Priority List (JITPL) Rules of Engagement Compliance Apportionment Guidance	Joint Force Commander Staff Element
Joint Force Air Component Commander (JFACC)	Air Tasking Order	Air Component Commander
Tomahawk Executive Agent (TEA)	Designate TSC Promulgate Concept of Operations Designate Tactical Tomahawk Data Base Manager (TTDBM) Implement "Forward Pass" Procedures Through TTDBM	Naval Component Commander (NCC)
TLAM Strike Coordinator (TSC)	Tomahawk Land Attack Missile (TLAM) Campaign with JFACC Logistics Support Plan Mission Planning Request(s) INDIGO TLAM Strike Cell Oversight Advance Deconfliction	NCC or Battleforce/Battlegroup (BF/BG) Commander
Launch Area Coordinator (LAC)	Launch Coordination/Preparation/ Execution Oversight Overwater Air Space Deconflication of the Immediate Area (Both Time and Space) Consolidated Reports	BF/BG Commander TACDESRON Commander or Launch Platform Commander

Supporting Arms Coordination Center (SACC)

Upon the initiation of planning for an amphibious operation, the commander amphibious task force (CATF) establishes a SACC. Through this agency, CATF exercises overall coordination of all supporting fires during the amphibious assault until such time as control of these fires are passed to the commander of the landing force (CLF). The SACC is staffed by personnel from the ATF and assigned landing force representatives.

The SACC is located aboard an amphibious ship configured with the communications facilities required to coordinate the employment of mortars, rockets, artillery, air, and naval surface fires. Currently, 14 ships possess this capability.[5] The SACC is organized into a naval gunfire section, air

[5] This includes Blue Ridge Class LCCs, Wasp Class LHDs, and Tarawa Class LHAs. Some Austin Class LPDs possess a more limited capability. The follow-on San Antonio Class LPDs may have a SACC capability.

support section, target information center, and a landing force fire support coordination section and functions under the supervision of the supporting arms coordinator (SAC). The SAC, with the advice of the LF fire support coordinator (FSC), integrates the fire plans of the supporting arms to ensure their most effective use in furthering CATF's concept of operations and supporting the LF scheme of maneuver. During an amphibious operation, the SACC is the primary agency that coordinates and controls all supporting fires.

If CLF transitions ashore, CATF passes responsibility for control and coordination of supporting arms upon CLF's request. Thereafter, CLF coordinates the fires of supporting arms through the force fires coordination center (FFCC) and subordinate fire support coordination centers (FSCCs) (Marine Corps) or fire support elements (FSEs) (Army). CLF is then authorized to assign NSFS missions directly to NSFS ships and to supervise execution of these missions. The change in responsibility for fire support coordination is based on established criteria, including the capability to coordinate all ground and air fires, and is contingent on CATF's decision. After passage of control and coordination responsibilities ashore, SACC assumes a monitoring status, prepared to resume control and coordination functions if required.

It is not unusual for control and coordination of supporting arms to be passed ashore incrementally. For example, CATF may retain responsibility for NSFS operations beyond the range of the LF being supported, but within range of fire support ships. The extended range of ERGM, and Tomahawk and the future AGS and ALAM has increased the likelihood of this situation.

The SACC will be disestablished after conclusion of an amphibious operation. However, NSFS missions may continue to support the follow on land operations. The senior fire support command and control agency ashore (i.e., FFCC, FSCC, and FSE) will then plan and coordinate the assignment and execution of all supporting arms: artillery, tactical aviation, and naval surface fires.

The advanced field artillery tactical data system (AFATDS) is being installed aboard SACC-configured amphibious assault ships to provide a SACC automation capability. This automation will support more robust sea-based operations enabled by the introduction of new, long-range weapons systems and the implementation of a naval sea-basing concept. AFATDS interfaces with the Air Force theater battle management core system (TBMCS). Interoperability between AFATDS and NFCS continues to be developed.

Force Fires Coordination Center (FFCC) and Fire Support Coordination Center (FSCC)

Various agencies and elements are established within the Marine air ground task force (MAGTF) to assist commanders in the execution of their fire support responsibilities. These agencies may be used for either amphibious or sustained land operations.

The MAGTF command element (CE) organizes an FFCC that is responsible for overall fire support coordination. FFCC complements and extends the fire support coordination efforts of other MAGTF elements. At each level in the ground combat element (division, regiment, and battalion), an FSCC is established as a coordination agency. The MAGTF FFCC handles fire support matters beyond the capability of the FSCCs such as resolving fire support issues that affect the MAGTF as a whole and interfacing with appropriate staff agencies of higher, adjacent, and external commands. FFCC and

FSCC are organized and supervised by FSCs and are staffed with representatives of Marine Corps and Navy supporting arms. During the initial phase of an amphibious operation while control and coordination responsibility of supporting arms is afloat, FFCC provides LF representatives to the SACC.

During sustained land operations the FFCC and each FSCC continue to plan and coordinate fires in support of the MAGTF within their respective zones of action. FFCC maintains close coordination with ground combat elements' (GCEs') FSCCs to integrate plans for close supporting fires and deep supporting fires. The capabilities of new extended range weapons will enable the engagement of targets well beyond littoral penetration points.

The commander landing force (CLF) may choose to exercise command and control while remaining afloat (sea-based). This decision may be based on the scheme of maneuver, the availability of C2 assets, the extended battlespace, or the desire to minimize the buildup of forces ashore. By remaining sea-based, CLF and his staff do not consume scarce LF combat and logistic resources nor do they create a lucrative target ashore. Still, CLF must effect positive control over LF fire support, to include NSFS, just as if he had established command ashore. In this case, CATF would pass responsibility for fire support coordination to CLF, with FFCC remaining afloat. FFCC would occupy existing SACC spaces. SACC representatives would continue to monitor activities and support FFCC representatives as needed.

Shore Fire Control Party (SFCP)

The battalion SFCP from the headquarters battery of the supporting artillery battalion is headed by a naval gunfire liaison officer (NGLO) and includes a battalion NSFS liaison team and an NSFS spot team. The NGLO acts as the liaison officer for the naval task force supporting the ground forces down to battalion level. They coordinate all naval surface fires in the vicinity of ground maneuver forces and advise the fire support coordinator on all matters pertaining to NSFS employment. These matters include capabilities, limitations, status of fire support ships, and targets suitable for NSFS. The liaison team assists the NGLO in coordinating NSFS functions in the FSCC. The spot team is normally employed with a company/team of the battalion. Spot teams call for and adjust NSFS.

Marine Liaison Element (MLE)

The Marine liaison element (MLE) is being developed within both Marine Forces Atlantic and Pacific (MARFORLANT/PAC) to provide Marine air-ground task force (MAGTF) and Marine component commanders with military and foreign area expertise to facilitate fire support planning and command, control, communication, and coordination with allied or coalition forces in expeditionary operations across the spectrum of conflict. The MLE will be organized into a headquarters section, coalition teams, supporting arms liaison teams, and firepower control teams. The MLE will be able to deploy a task-organized team with the following capabilities:

- Serve as liaison to allied and coalition forces as subject matter experts in Marine Corps doctrine, tactics, techniques, and procedures.
- Provide regional, linguistic, and cultural expertise.

- Provide teams to facilitate the planning and coordination of air, artillery and naval surface fires when operating with allied/coalition forces.
- Provide teams to perform terminal control of air and surface fires for allied/coalition forces.

The MLE will replace and enhance the capabilities of the deactivated 1st and 2nd Air and Naval Gunfire Liaison Companies (ANGLICO). Two ANGLICO units will still remain within Marine Forces Reserve.

ARMY AGENCIES/SYSTEMS

Fire Support Element (FSE)

FSEs are normally established from the maneuver company to corps level, and are provided by the supporting field artillery command. These elements advise the maneuver commander on capabilities and the effective use of fire support assets, and assist with planning and coordinating fire support. The FSE is directed and supervised by the fire support coordinator (FSCOORD).

At the division and corps level, fire support planning, coordination, and execution normally involve representatives from various elements. These elements include the FSE, Army aviation, electronic warfare support, air defense artillery, Air Force, and NGLO.[6] FSEs at Corps level and below are the focal points of Army fire support activities.

FSCOORD, typically the senior field artillery commander at the given echelon, ensures that all available means of fire support are planned for, integrated, and synchronized with the battle plan. FSCOORD has dual responsibility for implementing the force commander's fire support concept, as well as the command and control of his field artillery organization.

At the division and corps levels FSEs are similar in structure. They are located in the main and tactical command posts and, as required, in the rear area operations cell of the rear command post. Assisted by FSE personnel, the FSCOORD:

- Develops, disseminates, and implements the approved fire support plan.
- Advises the commander on fire support capabilities in support of committed maneuver units and expedites the processing of immediate fire support requests.
- Maintains status of command's available fire support means.
- Plans, controls, and synchronizes all lethal and nonlethal fire support for maneuver operations.
- Recommends priorities and allocates available fire support resources to support the maneuver operation.
- Responds to requests for additional fire support from the tactical command post (CP) rear CP, or other subordinate FSEs.
- Participates in and supervises the routine activity and coordination of the targeting process within the maneuver main CP.
- Coordinates with the Army Aviation C2 element regarding current artillery firing unit locations, changes to fire support coordination measures (FSCMs), and aviation control measures (ACM).
- Controls counterfires, if not managed by subordinate units.

[6] Currently, there are no NGLOs identified or staffed to support Army units.

- Coordinates air support through the tactical air control party (TACP).
- Coordinates suppression of enemy air defenses (SEAD).
- Coordinates combat aviation employment with fire support operations.

FSCOORD at the brigade level is the direct support field artillery battalion commander. They establish FSEs in each maneuver battalion and company. The battalion fire support officer (FSO), the FSCOORD for the maneuver battalion commander, is in charge of the FSE and is the principal fire support advisor. The FSO supervises and coordinates the training and actions of the company fire support teams. FSEs at brigade and battalion are located with the maneuver tactical operations center.

Fire Support Team (FIST)

At the company level, the FIST coordinates all fire support assets. A FIST consists of a four-man headquarters element in a combat arms company. The company FSO supervises the FIST and serves as the company FSCOORD. In an Infantry company, the FIST consists of a four-man headquarters element and a FO and radio-telephone operator (RTO) for each platoon. The company FSO supervises the FIST and serves as the company FSCOORD.

Deep Operations Coordination Cell (DOCC)

The DOCC serves as the center for focusing and integrating the planning, coordination, synchronization, and execution functions for all Corps-level deep operations. DOCCs may also be found at the division-level and at echelons above Corps. The primary functions of DOCC are promoting situational awareness; planning, synchronizing, and coordinating targeting; and executing deep fires to include controlling designated fire assets. These functions are performed simultaneously and continuously throughout the conduct of combat operations. The DOCC does not replace the functions of other fire support command and control agencies, but centralizes the process. The DOCC has the communications equipment, processing hardware, and personnel to interface with higher headquarters, joint, and national sensors. Either the chief of staff or corps artillery commander is normally the DOCC OIC and responsible to the commander for carrying out the functional tasks of the DOCC.

By interacting with other coordination elements, the DOCC will plan and coordinate the use of fires, combined arms maneuver, special operations forces, and Army airspace command and control in support of deep maneuver operations. The DOCC ensures effective and efficient employment of critical assets and facilitates synchronization of Joint operations. For example, the DOCC might request the use of naval fires to support the Army's deep battle.

Because of the time sensitivity of some missions, such as theater missile defense attack operations, the DOCC may establish direct communications channels to selected attack systems under its control. The DOCC is responsible to coordinate and/or deconflict the attack of targets when multiple delivery systems may be available, or are operating in the same general area.

Analysis and Control Element (ACE)

The ACE provides the intelligence, target analysis, and correlation support for the DOCC. The ACE develops and manages the collection plan to avoid duplication of effort among available target

acquisition assets. The intelligence directorate (G2/J2) controls the ACE. Sensors report priority acquisitions to the DOCC. These reports serve as trigger events for deep fire execution. The DOCC will normally use decentralized execution for certain high priority targets with relatively short dwell times. The DOCC incorporates routine, less time sensitive sensor reports into fire plans. Connectivity with ACE also provides the DOCC with timely BDA.

Battlefield Coordination Detachment (BCD)

The BCD is an Army liaison element provided by the Army component commander to the air operations center (AOC) and/or to the component designated by the joint force commander to plan, coordinate, and deconflict air operations. The BCD processes Army requests for tactical air support, monitors and interprets the land battle situation for the joint air operations center (JAOC), and provides the necessary interface for exchange of current intelligence and operational data. The BCD's mission is to establish the Army forces (ARFOR) liaison and interface with the JFACC. The BCD is normally collocated with the JAOC.

The BCD's mission encompasses the following:

- Exchanging operational and intelligence data and support requirements between the JFACC and ARFOR.
- Coordinating ARFOR requirements for CAS, and air interdiction.
- Communicating the Commander ARFOR's decisions and interests to the JFACC.
- Interpreting the land battle situation for the JFACC by ensuring the JFACC is familiar with the Commander ARFOR's scheme of maneuver and intent and the concepts for application of ground, naval, and air assets within the ARFOR's area of operations.
- Interpreting the JFACC's air operations situation for the ARFOR.
- Passing JFACC requests for ARFOR supporting fires.
- Coordinating the integration of ARFOR requirements for airspace control measures, joint fire support coordinating measures, and theater airlift.

The BCD must be prepared to operate with an Air Force AOC or Navy or Marine Corps tactical air control/command center (TACC) depending on which component is appointed as the JFACC.

Army Battle Command System (ABCS)

ABCS is designed to provide the battle commander and his staff with a common operational picture (COP), as well as all the information necessary to effectively plan, coordinate, control, and direct the battle. This includes the integration of battlefield functional area control system (BFACS) that extend from corps to brigade, with some components at the battalion level, that interface with both higher and lower ABCS systems. The primary components of ABCS include:

- Advanced field artillery tactical data system (AFATDS).
- Maneuver control system (MCS).
- All source analysis system (ASAS).
- Air and missile defense workstation (AMDWS).
- Combat service support control system (CSSCS).

- The tactical airspace information system (TAIS)
- The Global Command and Control System-Army (GCCS-A)
- Force XXI Battle Command for Brigade and Below (FBCB2) system

ABCS is interoperable with joint and multinational C2 systems at upper echelons, and it is vertically and horizontally integrated at the tactical and operational levels.[7]

AIR FORCE AGENCIES/SYSTEMS

Theater Battle Management Core System (TBMCS)

The TBMCS is designed to provide the tools to plan and manage the overall air war and prosecute the daily air war. TBMCS includes a suite of Air Force and joint software applications supporting aerospace operations planning and execution monitoring. The system has been undergoing development to support a sea-based JFACC air operations center (AOC) which incorporates existing Navy CTAPS hardware into a joint network system. TBMCS will replace CTAPS installations onboard Navy ships and is intended to play a C2 role in the detection and engagement of time critical targets.

DEVELOPMENTAL INITIATIVES AND EXPERIMENTATION

Exploration of new command and control architectures has significantly expanded during the last several years due to the rapid growth of computer technology that is being applied to command centers and fire support coordination agencies in all of the services. Traditional acquisition procedures for command and control software and hardware have required modification to keep up with the rapidly changing computer and communication landscape. To adjust to this new environment, each service has developed an experimental process to examine new concepts, to include command and control. What follows is a brief review of some of the developmental initiatives and experimentation by the services as related to land attack command and control.

Joint C4I Architecture

New surface combatant weapon systems will require coordination and deconfliction with joint agencies. The joint C4I architecture is an increasingly integrated architecture of systems, processes, communications, and nodes with common standards and protocols. Integrated C4I enables a smooth transition from forward presence forces to a fully developed joint force as reinforcements flow to the theater. Joint force systems will be integrated in each of the three subsystems of the joint C4I architecture. The subsystems are discussed in the following paragraphs.

Joint Planning Network (JPN)

The JPN is an emerging GCCS based network of electronic communications systems supporting force operational planning and situational awareness for the senior levels of command. It carries mostly non-real-time information. JPN provides access to planning information and the means to

[7] For a more detailed discussion of ABCS refer to FM 100-34, *Command and Control*.

exchange and distribute plans between commanders and their forces. Consequently, it enables distributed, collaborative planning.

Joint Data Network (JDN)

The JDN is an electronic communications network of tactical data links within the theater. Its principal elements are the tactical digital information links (TADILs)—Link-16, Link-11, Link-22, Link-4A—the Tactical Information Broadcast System (TIBS), and the Tactical Receive Equipment (TRE) Data Distribution System (TDDS). It carries near-real-time track data, force orders, engagement status and coordination data, tactical weapons control orders, weapon pairing and assignment orders, and space-based early warning information. The JDN provides tactical commanders and units time critical early warning, track, and C2 information for use during tactical operations.

Joint Composite Tracking Network (JCTN)

The JCTN is a network of electronic communications systems passing precision sensor measurement data and weapons engagement signals between cooperating units. The principal element of the JCTN is the cooperative engagement capability (CEC), a real-time network providing composite tracking, precision cueing, and coordinated cooperative engagements.

Joint Summary

These three interdependent subsystems serve different, mutually supportive purposes within the force by delivering timely access to tactical and non-tactical information and to key transmission mechanisms, as shown in figure C-1. Each network supports a different audience of interdependent users, dynamically channeling data, information, and intelligence. These three networks accommodate and exploit differences in certainty, detail, and scope among non-real time, near real-time, and real-time products.

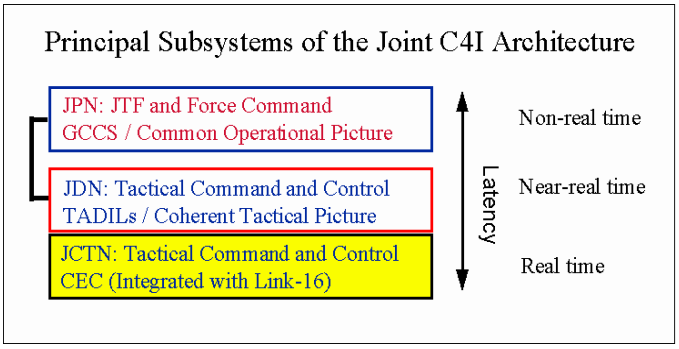

Figure C-1. Principal Subsystems of the Joint C4I Architecture

Naval Initiatives

With the introduction of extended range weapons, the Navy has an increased capability to influence operations ashore. Requirements for planning, coordination, and execution of fires have also in-

creased. The following sections discuss two proposed agencies (the naval coordination detachment and the naval fires coordination cell) to accomplish these expanded functions.

Note: The establishment of both the NCD and NFCC/NFC requires modification to existing doctrine, tactics, and organization. Organization and equipment requirements should be the focus of future studies and fleet battle experiments.

Naval Coordination Detachment (NCD) (Proposed)

The naval and amphibious liaison element (NALE)[8] is currently established by joint doctrine to provide coordination of air operations with the JFACC during the execution of amphibious operations. During other than amphibious operations, the Navy lacks representation to plan, coordinate, and deconflict air operations and long range fires with the JFACC. A naval coordination detachment (NCD), similar in function and organization to the Army's battlefield coordination detachment (BCD) is needed to provide experienced naval representation to the JFACC for coordination and planning. The functions to be performed by the proposed NCD include:

- Integrating and synchronizing naval component commander (NCC) deep operations and intelligence assets with those of JFACC.
- Advising JFACC of naval operations and the NCC of JFACC air operations priorities.
- Supporting coordination and scheduling of naval air and surface fires into the ATO when required.
- Coordinating naval fires with JFACC to engage targets of opportunity and time critical targets.
- Providing advice and planning guidance on naval fires to the joint force land component commander via interface with the collocated BCD.

Naval Fires Coordination Cell (NFCC) and the Naval Fires Coordinator (NFC) (Proposed)

During amphibious operations, the CATF operates within an amphibious objective area (AOA) and, in conjunction with the CLF, plans and coordinates fires to support the CLF's scheme of maneuver. SACC is the organization responsible for fires planning, coordination, and execution within the AOA.

Outside of an AOA, the NCC lacks a similar agency to coordinate naval fires within his area of operation. The naval fires coordination cell (NFCC) headed by the Naval Fires Coordinator (NFC), is a proposed organization to perform the fires coordination function for the NCC. This agency will integrate all naval fires with all other joint fires.

The NFC needs the capability to manage battlespace geometries to arbitrate conflicts in their use. Depending on the requirements of the operation, the NFC may be assigned to either Navy or Marine Corps control.

[8] If the NCD becomes a doctrinal agency, it would replace the NALE.

The NFC will be located either in the carrier intelligence center (CVIC) on an aircraft carrier or in the SACC on a large deck amphibious ship. The NFC must be equipped, manned, and trained with the appropriate personnel and C4ISRT assets to provide the level of coordination necessary for a given operation.

The mission of the NFCC would be to:

- Provide a focused, centralized element for the planning, coordination, and execution of all naval fires for NCC.
- Provide a streamlined, automated process to employ decide, detect, deliver, and assess targeting methodology in support of NCC deep operations objectives.
- Ensure the effective and efficient employment and resource allocation of NCC fires assets.
- Determine the optimal means of engaging detected targets based on location of attack assets, range, operational status, weapons availability, air defense threat, surface and subsurface threat, and accuracy of target acquisition systems.
- Link the NCC deep battle objectives with the supported commander's close battle.
- Coordinate with joint and allied fire support agencies to ensure the safe, effective, and efficient use of deep supporting fires.